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Evidence on Time-of-Day Pricing in the United States

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16. Abstract

This report examines the evidence on time-of-day transit pricing in the U.S., particularly in terms of ridership, fiscal, and equity impacts as well as with respect to various implementation issues. Thirty-two time-of-day transit fare programs have been initiated in the U.S. since the early 1970, of which twenty-two currently exist. These are about evenly split between off-peak discounts, peak-period surcharges, and programs involving differential rates of fare increases between peak and off-peak periods. Most fare differentials have been fairly modest to date (i.e., around 10-15¢), though there have been several cases where peak charges exceed off-peak ones by 35¢. Regarding the duration of the designated peak period, the most common time span chosen was 6 hours. From interviews and site visits, it was also found that the most prevalent reason for adopting time-of-day pricing was to encourage ridership shifts to the off-peak. Unfortunately, however, there was little empirical evidence to suggest that time-of-day fare programs to date have accomplish just that, although in most cases the proportion of total ridership during off-peak periods rose. Statistical analysis revealed off-peak users to be more sensitive to fare changes than their peak period counterparts, with midday discount programs demonstrating the most prolific ridership impacts. Before-and-after analysis generally showed that the time-of-day fare programs had fairly inconsequential effects on farebox recovery, operating performance, or the composition of ridership, ostensibly due to the nominal size of most differentials. The most successful programs were those which collect fares on the basis of run direction (rather than exact time) and which aggressively marketed their programs.

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Executive Summary

Evidence on Time-of-Day Transit Pricing in the United States

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Since 1970, over thirty areas in the United States have introduced adult transit fares which vary by time of the day. Of these, 12 programs were eventually discontinued, leaving some 23 areas in the U.S. with time-of-day pricing as of late 1983.

Interest in time-of-day transit pricing has been prompted largely by the U.S. transit industry's worsening financial situation over the past several decades. Nationwide, deficits rose from under $300 million in 1970 to over $4.4 billion in 1982. With operating subsidies becoming less of a sure thing, fare structures which attempt to approximate the costs of providing different types of services are gaining increasing popularity. By charging higher rates during peak versus off-peak periods, time-of-day pricing is touted by some proponents as being both more efficient more equitable than flat fare alternatives.

This report provides a comprehensive view of time-of-day fare programs which have emerged in the U.S. to date -- examining how they vary, the motivations behind them, the range of impacts experienced to date, and various implementation issues which have surfaced. Particular attention is given to the effects of time-of-day pricing on ridership levels and composition, farebox recovery, and operating performance. Emphasis is also placed on highlighting exemplary cases of these fare programs. Care in the collection of time-of-day fares and clever marketing are found to be particularly important ingredients of successful programs. Although circumstances varied among individual properties, the overall effects of time-of-day fares to date on ridership and productivity have been fairly modest. The report concludes with specific recommendations for improving time-of-day pricing. More in-depth property-by-property examinations of time-of-day pricing are provided in Appendix I of Volume 2 of the report.

<u>Features of Time-of-Day Fare Programs</u>.

Three main types of time-of-day fare programs were found in the research: peak surcharges (whereby peak fares were raised from the base level); off-peak discounts (whereby only off-peak fares were lowered from the base level); and differential fare increases (whereby fares were increased more for peak than off-peak periods from the previous base level). The 32 cases of time-of-day pricing which have emerged to date were found to be about evenly split between these groups. Time-of-day fare programs introduced during the sixties tended to be of the off-peak discount variety whereas more recent programs have been almost exclusively surcharge arrangements, reflecting today's tighter fiscal environment. Surprisingly, no cases of a simultaneous peak fare increase and off-peak decrease were found. Evidently, transit agencies

fear that such a fare change would disenfranchise peak hour customers by creating too glaring of a disparity in fare rates. This is perhaps also the reason why the average differential has only been around 15 cents, ranging from a nickel in Washington and Baltimore to 35 cents in Columbus, Denver, and Palm Springs. In relative terms, the highest differential has been Boston's 150 percent. For almost all systems studied, moreover, the size of the initial peak/off-peak differential has been eroded by inflation. Only in the cases of Burlington (Vermont), Denver, and Cincinnati have the initial time-of-day differentials been widened over time.

An assortment of time-of-day pass programs were also found. Six areas provided passes discounted at a higher rate during the off-peak, while four required peak period surcharges in combination with passes. Four areas also used discounted multi-ride tickets good only for off-peak periods, while two areas offer off-peak-only discounted tokens. These prepayment provisions are particularly noteworthy in that off-peak users are receiving fare incentives comparable to those enjoyed by rush-hour passholders.

Fairly wide time bands were often used for designating peak hour time periods, particularly among larger transit properties. In the case of Washington's Metrobus and Metrorail, the designated morning and evening peak spans seven hours. For most other properties, six hour peak periods were designated. While a wide time band can increase revenue yields, it also discourages shifts in ridership between periods since the number of potential beneficiaries becomes small. The predominance of wide peak time bands in large areas reflected both the tendency for peak ridership to be more evenly distributed in these settings and their greater vulnerability to revenue losses from riders shifting to the shoulders of the peak. Wide bands were also chosen to reduce the incidence of fare disputes since fewer passengers would be boarding at the time switchover. Midday discount programs, on the other hand, generally involved five to six hour discount periods which concentrated on lunchtime.

From extensive on-site and telephone interviews, it was found that the most frequently-cited reason for instituting time-of-day pricing was to encourage increases in off-peak ridership, primarily through shifting. This was usually the primary motivation behind off-peak discount programs. The next most frequently cited reason (11 of 31 systems) was to increase farebox revenues, promoted mainly by areas introducing peak period surcharges. Other justifications were to effectuate cost-based pricing, to minimize ridership losses (through peak-only price increases), to help the disadvantaged, and to strengthen downtown areas. Several site-specific rationales were also cited, such as a state mandate which forced Minneapolis to restrict its 1981 fare increase to the peak period. In general, all time-of-day programs were political artifacts, the products of many different stimuluses as opposed to any one factor.

Interviews were also conducted among managers of ten (non-demonstration) time-of-day fare programs which were discontinued during the seventies and early eighties. In Akron, Baltimore, Boston, Palm

Springs, Rochester, St. Louis, and Youngstown, excessive revenue losses from time-of-day pricing prompted the return to flat fares. (Both Akron and Youngstown later reinstated their off-peak discount programs.) In Albuquerque, Kansas City, and Walnut Creek (California), increases in fare disputes and other implementation problems led to the differentials' abandonment. Moreover, there appeared to be an absence of direct beneficiaries of lower off-peak fares in many settings, ostensibly because senior citizens, who often predominated off-peak patronage, were already receiving substantial discounts anyway. In general, users were indifferent to the elimination of off-peak pricing, reflected by the paucity of formal protests lodged at public hearings on the fare conversions.

<u>Ridership, Fiscal, and Equity Trends and Impacts</u>

Data limitations, stemming from the fact this research was conducted "after-the-fact", restricted the analysis of ridership, financial, and equity impacts. Nevertheless, an assessment of trends associated with the fare changes provided some useful insights. Most areas which introduced off-peak discounts experienced significant gains in ridership, with the average increase (from year before to one year after the fare change) in the neighborhood of 10 percent. Fare elasticity estimates revealed that discounts seemed more effective at boosting overall ridership than a comparable, at least in terms of average fare, uniform lowering of fares. With peak surcharges and differential increases, ridership consistently declined, on average around 10 percent in the case of the former and around 15 percent in the case of the latter. Patronage losses, however, were generally less than what would be expected from an across-the-board fare hike which produced the same average fare. Collectively, then, these trends suggest that the ridership effects of time-of-day pricing, whatever form it may take, are generally far superior to those of flat fare changes.

Unfortunately, attempts to gauge the degree of across-period shifting and to compute cross-elasticities were unsuccessful due to data limitations. However, data on the distribution of ridership by time-of-day revealed that the off-peak share rose in about half of the areas which introduced discounts. Importantly, areas with the largest relative discounts and the longest designated midday periods appeared to enjoy the greatest increases in off-peak shares. In Columbus, Ohio, for instance, a 35 cents discount extended over the midday hours of 9:30 a.m. to 3:00 p.m. was followed by midday increase in the share of total ridership from 36 percent to 44 percent. In contrast, peak surcharge programs seemed to have an imperceptible influence on ridership distribution.

A more detailed econometric analysis of ridership impacts in seven areas produced fairly mixed results. In Allentown, Pennsylvania and Akron, Ohio, off-peak fare discounts, controlling for other factors, seemed to have few positive effects on ridership, at least in comparison to uniform price changes which both areas have introduced. In both Cincinnati and Columbus, on the other hand, off-peak users were found to be extremely sensitive to lower fares, in general more than twice as much as their peak period counterparts. And in Denver, Colorado and Orange

County, California, riders seemed to be fairly insensitive to higher peak fares, whether in the form of a peak-only surcharge or a flat fare increase. Overall, this research suggests that discount programs seem to have been more effective at increasing ridership than surcharge programs have been at forestalling patronage losses.

Of course, the superior ridership effects of off-peak discounts must be weighed against their financial performances. In all cases, off-peak discount programs witnessed a decline in the share of expenses recovered from fares (i.e., cost recovery), with rates falling by more than 10 percent in seven cases. By comparison, cost recovery rates generally increased by 5 to 10 percent for most systems which introduced either peak surcharge or differential fare increases. No relationships were found between the relative size of the differentials and financial impacts. Although numerous other factors have undoubtedly affected systems' financial performances, it was nonetheless clear that fiscal improvements have generally accompanied peak surcharges whereas with off-peak discounts the obverse has been true.

A common argument in favor of time-of-day transit pricing is that unit costs can be lowered by more efficiently allocating both capital and labor throughout the day. No significant changes in peak-to-base period ratios of vehicles or employees were found, however, to suggest that equipment and manpower were being deployed more efficiently following the inauguration of time-of-day pricing. Only in the cases of off-peak discount programs did there tend to be a slight reduction in this ratio. However, for four larger systems -- Minneapolis, Orange County, Sacramento, and Washington, the ratio of peak to base buses did decline by over 7 percent within one year of introducing surcharges.

Moreover, the sizes of properties' labor forces were generally found to be unaffected by time-of-day pricing in most places. By shaving peak services in response to ridership shifting to the off-peak, one would hope that both overhead expenses and workforce size could be trimmed down under time-of-day pricing. Except in a few cases, total numbers of employees continued to increase following the introduction of time-of-day fares in all areas. Moreover, labor productivity, as reflected by vehicle-miles per employee, usually continued along a downward spiral even after the inauguration of time-of-day pricing. Undoubtedly, factors other than the fare programs themselves have had a hand in this slippage.

Individual case analyses did reveal more positive efficiency impacts of time-of-day pricing, however. Rochester's transit authority, for example, redeployed 10 of its peak hour runs to the off-peak and shaved its peak fleet of buses following its 1975 lowering of midday fares. Columbus's bus system also reassigned numerous driver tours. There, seat occupancy during the midday rose from 40 percent to 63 percent, to the point where load factors are now the highest during the noontime. Columbus's 25 cents midday fare, coupled with free midday downtown services, has led to an oversubscription problem, however. Because of excessive noontime crowding, the incidence of scheduled buses running late 3 minutes or more rose by 22 percent following Columbus's initiation of a combined midday discount/free downtown service.

In terms of other efficiency trends, there was an average decline in revenue passengers per mile following time-of-day pricing among the systems studied, though this did vary markedly among properties. Notably, in Denver and Columbus, two areas with the largest absolute differentials, this measure increased by 10 percent one year after time-of-day pricing was introduced.

There's also anecdotal evidence that midday discounts have had positive impacts on downtown retail activities in several areas. The most impressive results have been in Columbus where daily ridership to downtown rose by one-third during the first month of the city's new incentive fare system. One year latter, sale tax revenues dedicated to the local transit system rose by $2 million more than had been expected, effectively reducing Columbus's need for state and federal operating assistance. Local officials attribute the boom in sales volumes to the multiplier effect of stimulating downtown business activities through the promotional fares. Columbus officials proudly note that sales tax revenues rose 14 percent during the first month of the fare program, while for the same period during the previous year they decreased 10 percent. One would expect, however, any sales tax gains to be related to larger regional economic forces. That is, in the absence of a growing economy, any increases in downtown business sales would be purely redistributive -- i.e., taking away retail transactions from non-CBD areas. Nevertheless, the fact remains that Columbus is in a financially more viable position than several years ago (because of tremendous gains in dedicated sales tax receipts), lending some credence to the assertion that more efficient pricing yields important secondary community benefits.

This research also examined the effects of time-of-day pricing on ridership composition to see whether the contention that fare differentials would benefit the poor and disadvantaged groups the most (as evidenced by their increased usage) appears valid. The distributional effects of time-of-day pricing were found to be quite modest. This was probably because most time-of-day fare differentials were so small as to diffuse impacts among user groups. Among six properties for which data were available, only in Columbus and Minneapolis did the differential appear to influence ridership mixes to any noticeable extent. In Columbus, the share of older, minority, and low-income users increased overall, however the proportion of choice riders rose markedly during the midday. And in Minneapolis, some shifting of lower income, school-aged, and captive users to the off-peak was found following the add-on of a 25 percent peak surcharge.

To summarize the impact findings of this research, riders generally responded more strongly to off-peak discounts than peak period surcharge programs, although trends varied among individual properties. Evidence on ridership shifting was rather scant, though discount programs with long designated midday periods and large percentage differentials seemed to experience some redistribution to off-peak hours. Agencies' financial solvency, operating efficiency, and effectiveness at generating additional trips (per unit of service provided) seemed only modestly influenced by time-of-day pricing. Peak surcharge programs, however, generally enjoyed gains in cost recovery rates while discount programs

suffered losses. Finally, arguments that equity benefits will result from time-of-day pricing did not seem to be borne out by this research.

Implementation and Political Issues

Making time-of-day pricing work, both logistically and politically, is a major hurdle to overcome in the minds of many. Several important strategies which facilitated the implementation of time-of-day pricing deserve special attention. Foremost are some of creative ways devised for coping with the "boundary problem" -- i.e., collecting fares at the changeover point from the off-peak to peak period and vice-versa. Nearly one-third of all properties collect their differentials on the basis of individual bus runs or arrival at a major activity center rather than according to the specific hands on the clock. Run-based collection virtually eliminates fare disputes, more closely approximates cost variations, and provides the flexibility needed to make differential pricing manageable. In instances where run-based collection is used, individual bus schedules were shaded or printed in bold-face lettering to highlight exactly where, rather than when, fare rates would change.

Special signage was also used to facilitate the fare collection process. Moreover, coinage was chosen in Columbus (25 cents) and Denver (35 cents token) to reduce change handling in order to expedite the boarding process during high-volume midday hours. In addition, in almost every case studied, drivers were encouraged to exercise discretion when collecting differentials. Although there was some indication of fare evasion in several areas following the introduction of time-of-day pricing, overall there seemed to be a collective spirit of cooperation among users and drivers in enforcing the fare programs.

Another important aspect of implementing time-of-day pricing is the general receptiveness of different groups and special interests to the fare reform. From interviews and site visits, numerous individuals were polled regarding their reactions as well as the reactions of others to the fare changes. In general, most groups seemed fairly indifferent toward time-of-day pricing. Interviews with transit managers indicated that board members of over three-quarters of all areas were supportive of time-of-day pricing, considering it a more "business-like" practice. In areas where board members were initially skeptical, apprehensions tended to wane within several months of implementation. Interviews with drivers revealed that complaints over fare collection were generally related more to matters such as exact payment, multiple passes, and zonal charges rather than the time-of-day differential. In fact, some found time-of-day pricing to be a simplification of previous fare practices. No instances were found whereby drivers used the differential program and its greater likelihood for fare disputes as a bargaining chip during wage negotiations. Moreover, a national survey of transit managers conducted as part of this research found a resounding base of support for time-of-day pricing, boding well for its future.

Although there were scattered incidences of user complaints immediately following the introduction of peak surcharges in several areas, acceptance generally came quickly. Aggressive marketing and educational

programs certainly had something to do with this. However, the fact that differential pricing was already institutionalized in several areas and that time-of-day fares were actually simplifications of earlier fare practices in others also worked in their favor. Moreover, in that the vast majority of users ended up paying the same fare regularly, the differential itself became a non-issue. There were very few instances of peak period customers complaining about unfair treatment. Apparently, the adoption of fairly small differentials helped to assuage any potential ill-feelings. A number of transit managers interviewed volunteered that a small differential was consciously chosen initially to guard against alienating any one group, though with the intention of eventually widening it. As mentioned previously, few properties have actually increased their differential over time, however.

Perhaps the most vocal user protests were over the specific designation of the peak time bands rather than the fare rates themselves. In Denver, Washington, and several other areas, users outwardly complained at public hearings that the designated peak hours were too long, thus limiting their abilities to take advantage of lower fares. Although longer peak hours enhance revenues and perhaps reduce the incidence of fare disputes, the discouragement of shifting is perceived by many to be a major drawback. Finally, there were a few instances where certain groups of users were intimidated by the fare differentials. In Orange County, for instance, bus drivers have reported a high incidence of over-payment during off-peak periods among non-English-speaking patrons, primarily southeast Asians and Latinos, who simply don't understand the differential and are fearful of being accused of cheating.

The general public receptiveness to time-of-day pricing was unquestionably due, in large part, to effective marketing and user informational campaigns. Many systems launched aggressive promotional campaigns using extensive media coverage, newspaper advertisements, radio announcements, on-vehicle brochures, educational films, and areawide posters to inform the public about time-of-day pricing. A particularly useful marketing ploy adopted by a number of properties was to sell the fare program to the public as a discount fare rather than a peak surcharge, regardless whether it was or not. Most off-peak discounts were marketed as "bargain" and "incentive" fares, rather than peak/off-peak differentials. This tended to cast each program in a positive light and also avoided any hint of discriminatory pricing between peak and off-peak users. In the cases of peak surcharge and differential increase programs, the marketing tactic usually chosen was to emphasize the benefits of off-peak travel rather than the higher cost of peak period usage. These marketing strategies parallel those currently being used by many oil companies whereby emphasis is placed on receiving "cash discounts" rather than any mention of "credit card surcharges".

An investigation into the role of the private sector in promoting time-of-day pricing found that most of the involvement was limited to business merchants giving away free bus tokens and promotional prizes during the first week or so of some programs. The give-aways were linked to service improvements as much as the fare programs in most areas, however. Few instances where time-of-day pricing was implemented as part of a flex-time or staggered work hour program were found. In

the one case where time-of-day pricing was introduced specifically in combination with flex-time -- Duluth, Minnesota, the demonstration was discontinued after one year because virtually no employers participated. In the absence of joint public and private coordination of work schedules and fare policies, it is perhaps no great surprise that the level of ridership shifting found was fairly inconsequential. It is probably the case that private interests need to feel that there's something in it for them, such as in the case of Columbus, if they are to actively promote and support time-of-day pricing or any other fare innovation.

Finally, the political events which shaped fare policy outcomes in Cincinnati, Columbus, and Washington were closely examined as part of this research. Several common themes emerged from these case studies. In all three places, time-of-day pricing, in and of itself, was clearly not the centerpiece of each area's fare policy. Rather, it was part of a larger funding package aimed at accomplishing a specific cost recovery target as well as geographically spreading transit's financial burden. In Cincinnati, for instance, zonal fares and a dedicated payroll tax (aimed at non-residents) are employed along with peak period surcharges in an effort to exact high levels of regional funding support from suburban residents. Time-of-day pricing was generally perceived by politicians in these areas as a means of collecting revenues in line with the costs of providing services to suburban versus central city areas. Overall, time-of-day fares have not been products of a rational decision-making process, but rather have evolved incrementally in response to concerns over fiscal expediency and regional equity.

Conclusion

Although hopefully new insights into the problems and opportunities presented by time-of-day pricing have been gained through this research, our knowledge regarding possible ridership and fiscal effects of such fare reforms remains somewhat incomplete. In particular, the ability of time-of-day fares to bring about significant shifts in ridership from peak to off-peak periods remains unclear. Of course, data limitations have been a big part of the problem. But the fact that most of the differentials which have been implemented to date are fairly nominal, plus the absence of a true peak-increase/off-peak-decrease fare change, have been limiting factors as well. Moreover, in that many differentials have been eroded by inflation since they were first introduced, the dearth of significant ridership and performance findings perhaps represents no real surprise. It is probably also the case that the wide time bands chosen by many transit properties to represent the peak period effectively prevented many passengers from shifting over to the lower-priced off-peak periods. It is apparent that the lack of significant findings reflect all of the above reasons as well as the fact that few, if any, time-of-day fare programs to date have closely reflected cost variations between peak and base periods, at least nowhere near to the extent the peak-load pricing proponents have long been arguing for.

If the effects of a substantial peak/off-peak fare differential are to be accurately gauged, it is felt that a carefully designed and administered demonstration program needs to be launched. A more controlled

experimental setting is essential if the incidence of ridership shifting induced by time-of-day pricing is to be measured. It is also felt that a panel study, wherein the same group of riders are sampled both before and after a fare change, would yield the most useful insights into the distributional consequences of time-of-day pricing.

Ideally, a demonstration program involving a combined peak-increase/off-peak-decrease fare change should be sponsored. The size of the differential should also be significant, on the order of 100% or more, as opposed to the 10%-15% commonly used by transit properties today. In addition, every effort should be made to enlist the support of the private sector in coordinating various flex-time and staggered work hour programs with time-of-day pricing. If transit ridership is ever to be significantly redistributed throughout the day, some readjustments in work scheduling will be necessary on a meaningful scale.

This research suggests that both off-peak discounts and peak surcharges, as well as various combinations thereof, can yield positive dividends to a transit agency as long as they are carefully implemented and other reinforcing factors accompany them. Run-based fare collection seems to be far superior to time-based approaches, and are strongly recommended for any agency contemplating time-of-day pricing. Importantly, driver-user confrontations can be avoided with a well-planned run-based collection system. Creative marketing of the fare programs, along with user informational campaigns, are also important prerequisites of major pricing reforms. In particular, this research found that there was less public resistance when differentials were marketed as "bargain" off-peak fares, without any reference to higher peak period rates. This marketing ploy can cast the fare program in a more positive light without alienating transit's bread-and-butter customers, those riding during peak hours. It is also essential that careful attention be paid to the designation of peak and off-peak hours when setting up a program, mindful of the trade-offs involved. Although lengthy peak periods usually generate more revenues than narrower ones, they have probably been major deterrents to significant ridership shifting as well. It is felt that peak period time bands need to be seriously re-evaluated in some areas with an eye towards encouraging shifting. Along this same line, every effort should be made to implement time-of-day pricing in combination with flex-time programs. Both public and private interests could materially benefit by doing so.

Of course, there are no prescribed formulas which guarantee if an agency does a number of different things, then a successful time-of-day fare program will result. Numerous factors, many of which are uncontrollable, have varying degrees of impacts on any fare reform's outcome. Changing gasoline prices, regional economic conditions, the leadership skills of local transit officials, the introduction of complementary service improvements, and a host of other forces have some bearing on time-of-day pricing's degree of success. But among the factors which a transit agency can directly control, run-based collection, inventive marketing, and the careful designation of time bands all seem to be important ingredients of successful time-of-day fare programs.

Preface

Many people gave their time and energies unsparingly in supporting this research. Our special thanks goes to the managers and staffs of the thirty-three transit agencies who kindly supplied the reams of background materials which were essential to the completion of this study. Those who assisted by doing everything from xeroxing agency reports to tracking down historical data are too numerous to list here, but remain the unsung heros of this research. Among those who deserve particular recognition are Jim Reading and Tim Grzesiakowski (Columbus), Hank Sokolnicki (Cincinnati), Aaron Isaacs (Minneapolis), Phil Sulentich (Akron), Bob Hartwig (Orange County), John Fularz and Bob Pickett (Washington), Cynthia Felice (Seattle), Thomas Burke (Erie), Catherine Debo (Burlington), Lee Fox (St. Louis), Pilka Robinson (Sacramento), and John Neff (APTA). The names of others deserving of special recognition have surely been left out, but to all of those who helped us with the drudgery of compiling information, our heartfelt thanks.

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Robert Cervero was the Principal Investigator of the project and directed all phases of the research. Professor Cervero prepared the final document, writing Chapters One, Two, Three, Five, Seven, Eight, and Nine, the Executive Summary, Appendices, and portions of other chapters. Mark Hansen, Therese Watkins, and Joel Markowitz were research assistants on the project. Mark contributed to Chapter Four, Therese helped write Chapter Six, and Joel wrote parts of Chapter Eight. The views and opinions expressed in the report are solely the author's and do not necessarily reflect those of the U.S. Department of Transportation, Urban Mass Transportation Administration.

Table of Contents

List of Figures

List of Tables

List of Exhibits

Chapter One

Introduction -- Defining the Issues

1.1 Context of the Problem

Since 1970, over thirty U.S. transit properties have introduced fares for adult customers which vary by time of day. These programs have ranged from additional surcharges for rush hour services to fare discounts during the midday and bargain passes limited to off-peak periods. Time-of-day fares have been implemented on conventional bus, rapid rail, and demand-responsive (i.e., dial-a-van) modes of public transportation, and in metropolitan areas as small as 25,000 and as large as 5 million persons. Fare differentials have ranged from a nickel to over one dollar, and have been as large as 300% in relative terms.

Time-of-day pricing represents a significant departure from the flat fare policies which have become so prevalent in the U.S. over the past several decades. Unlike uniform fares, time-of-day differentials attempt to encapsulate the higher overhead and staffing costs of accommodating rush hour loads, while charging non-peak users a fare reflective of basic level services. Charging more for peak period usage can increase farebox returns in that rush-hour transit commuters tend to be less sensitive to higher prices than other patrons, mainly because they're locked into a fixed work schedule and are making essential trips. On the other hand, giving a break at the farebox to non-peak users can significantly increase patronage. Differential fares can also serve to efficiently ration capacity -- relieving overcrowding during morning and evening rush hours, while helping to fill spare seats during the off-peak. A more even distribution of demand throughout the day can ultimately mean a substantial cash savings to transit properties. In addition, given that rush-hour commuters generally have higher incomes than off-peak customers, peak period surcharges are considered to be an equitable alternative to across-the-board fare increases.

Despite some compelling arguments to be made for time-of-day pricing, flat fares remain the industry norm, primarily because they're simple to collect and less intimidating to the riding public. Time-of-day fares have been resisted for other reasons as well. Some rush hour commuters reason that they should be rewarded at the farebox for their frequent patronage, so having to pay a surcharge in order to ride (or stand) in slow, crowded buses is apt to be viewed as "adding insult to injury". Fare differentials also increase the likelihood of confrontations between drivers and customers over what the correct payment should be. Service quality can also suffer when a more complex rate structure slows down the boarding process and leads to disputes. The fact that nearly one-third of all U.S. properties which introduced time-of-day pricing since 1970 eventually dropped them bespeaks to the difficulties of making differential fares work in practice.

However, there is every reason to believe that differential fares will gain popularity, rather than falter, in the future. Foremost is

the difficult financial situation many American transit systems currently find themselves in, struggling to increase farebox yields and control costs. Among the many prescriptions being proposed is cost-based pricing -- i.e., fare structures which reflect cost variations and offer greater revenue productivity. The rapidity of fare increases in recent years has also brought equity to the forefront of local transit issues. Recent court challenges against across-the-board fare increases in Pittsburgh, Atlanta, Philadelphia, and other places have prompted local officials to seriously consider zonal and time-of-day pricing alternatives. With base fares approaching the one dollar mark in many large American cities, more efficient and equitable pricing options will likely receive more serious attention throughout the eighties.

In addition to time period, fares can be differentiated on the basis of trip distance, service type, direction of travel, or even transit route. Each option involves varying levels of complexity, depending upon local demand and cost characteristics (e.g., level of peaking; extent of suburbanization in region). Some observers have noted that time-of-day fares stand as good of a chance for widespread acceptance in the U.S. as any other cost-based pricing option primarily because no technological changes are involved in implementation and they're not overly difficult for the riding public to comprehend. Also, time-of-day fares, more so than other options, are aimed directly at what many consider to be transit's greatest nemesis -- the peak. By redistributing demand and encouraging greater off-peak usage, time-of-day differentials offer hope for abating the cost pressures imposed by peak services. Moreover, some note, consumers generally have some experience with such comparable time-based pricing programs in other industries as lower long distance telephone rates during non-business hours, night-coach airline saverfares, and weekend car rental discounts. Finally, experiences with lower fares during off-peak hours for senior citizens could prompt some systems to extend such incentive programs to all users.

It is against this backdrop of competing arguments for and against time-of-day transit pricing that this report has been prepared. The fact that a significant number of U.S. transit properties have implemented time-of-day fare programs over the past decade, some retaining, others abandoning them, suggests that important policy lessons can be learned by studying what has occurred in the field. This report aims to provide a comprehensive view of U.S. time-of-day transit fare programs which have emerged to date -- examining how they vary, the motivations behind them, the range of impacts experienced to date, and the various implementation strategies which have been pursued. Particular attention is given to the ridership and financial implications of these fare systems as well as to understanding the various political and institutional issues involved with such fare reforms. Emphasis is also placed on identifying those factors and prerequisites which seem important towards the successful pricing of transit services by time-of-day and highlighting exemplary and perhaps not-so-exemplary cases of these fare programs. Overall, it is found that most time-of-day pricing programs to date have been moderately successful, at least in terms of serving their intended objectives, however modest they may be. Careful attention to how the fare program is designed and adapted to a system's particular operating environment, how fares are collected, and how the differential is

marketed and presented to the public are found to be essential elements of successful programs.

1.2 Dilemmas in the American Transit Industry Prompting Greater Concern over Fare Policies

The American public transit industry today finds itself in a serious financial situation, and fare policies over the past decade bear some of the blame. Between 1970 and 1982, expenses rose from about $2 billion to $7.5 billion compared to an increase in operating revenues from about $1.7 billion to $3.1 billion (Figure 1.1). Overall, expenses have increased at about twice the rate of inflation over this period while revenues have grown at only about one-half this rate. (Figure 1.2 reveals this using constant dollars). Consequently, the industry has gone from being nearly self-sufficient in 1970 to operating $4.4 billion in the red twelve years later (Figure 1.3).

Runaway operating deficits have meant increasing reliance on government subsidies, as shown in Figure 1.4. In 1982, 78 percent of the $4.4 billion deficit was financed through local and state treasuries, with the remainder coming from the federal largesse. Clearly, the past decade has witnessed a marked shift in the financial burden of public transit -- from the user to the taxpayer. Pressures to reduce government spending, however, suggests that this trend may be short-lived. Following a decade of secular decline, average transit fares in the U.S. actually rose to 51 cents in 1982, an increase of 12% from the previous year (Figure 1.5). The downward spiral in average fares during most of the seventies, by contrast, was precipitated by the availability of operating subsidies. A recent study by Lee (1983) estimates, in fact, that nearly one-quarter of all operating assistance during the seventies became substitutes for transit fares, with the vast majority of dollars being consumed by higher input costs for labor.

1.2.1 The Role of Fare Policies in Transit's Decline

Operating subsidies not only had a hand in depressing average fares. They also enabled transit properties to simplify pricing by replacing differentiated fare structures with uniform charges. With government aid to fall back on, virtually every major U.S. operator abandoned some form of differential pricing during the seventies in favor of a low flat fare. Of 25 urban areas with populations above one-half million in 1970, 17 had zone fares while 8 had flat ones (U.S. Department of Transportation, 1976). Today, except for some cases of graduated pricing of express services and a few instances of peak period surcharges, all but a few of the nation's largest transit systems currently operate under uniform fares.

It is noteworthy that this changeover occurred at the same time operators began expanding routes into outlying areas and intensifying peak services. Because of suburbanization pressures, it has been estimated that the average length of bus routes nearly doubled between 1960 and 1975 (Sale and Green, 1979). For the same period, the ratio of buses operating during the peak to those in the off-peak rose from 1.80 to 2.04 (Oram, 1979). These trends have clearly increased operators'

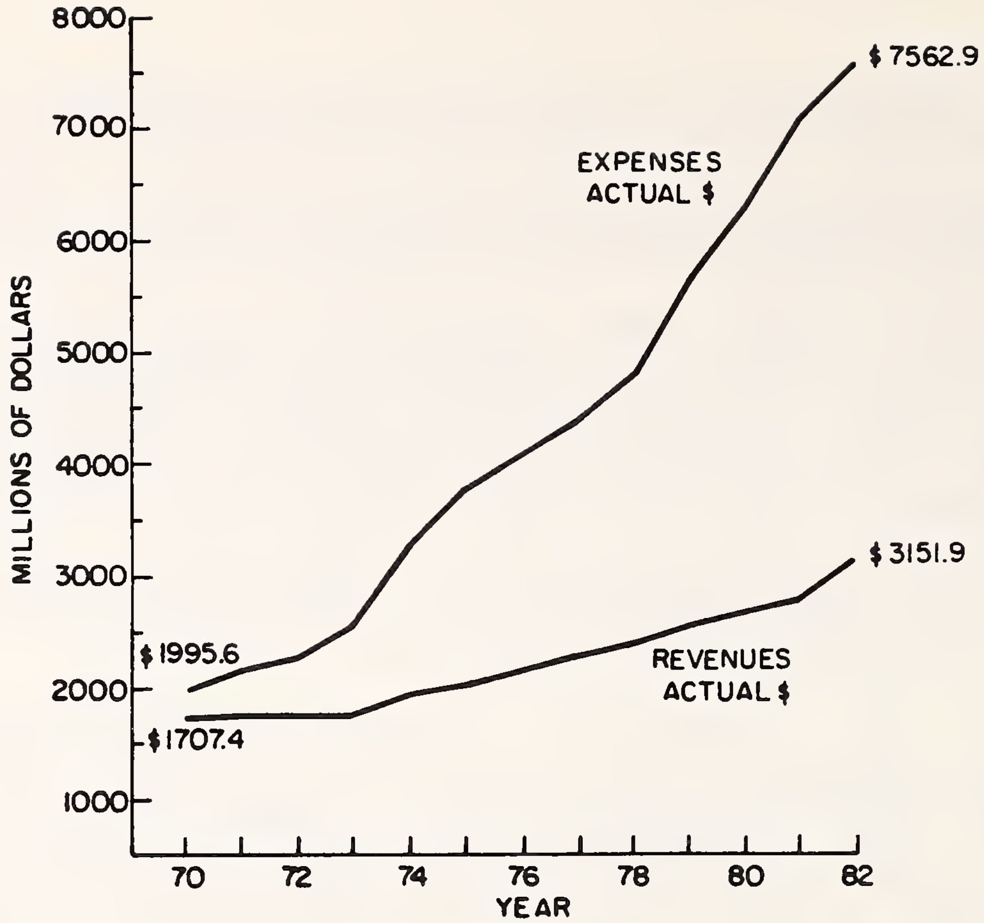

Figure 1.1. Comparison of Operating Revenues and Expenses for all U.S. Transit Systems, 1970-1982, Actual (Constant) Dollars

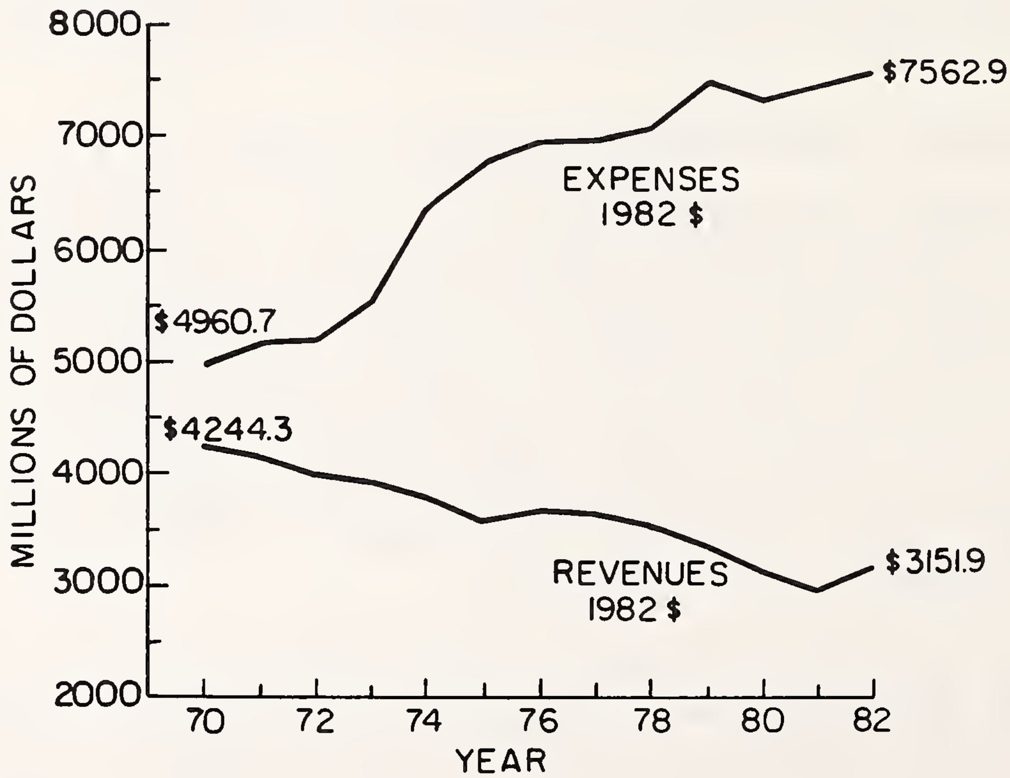

Figure 1.2. Comparison of Operating Revenues and Expenses for all U.S. Transit Systems, 1970-1980, Constant 1982 Dollars

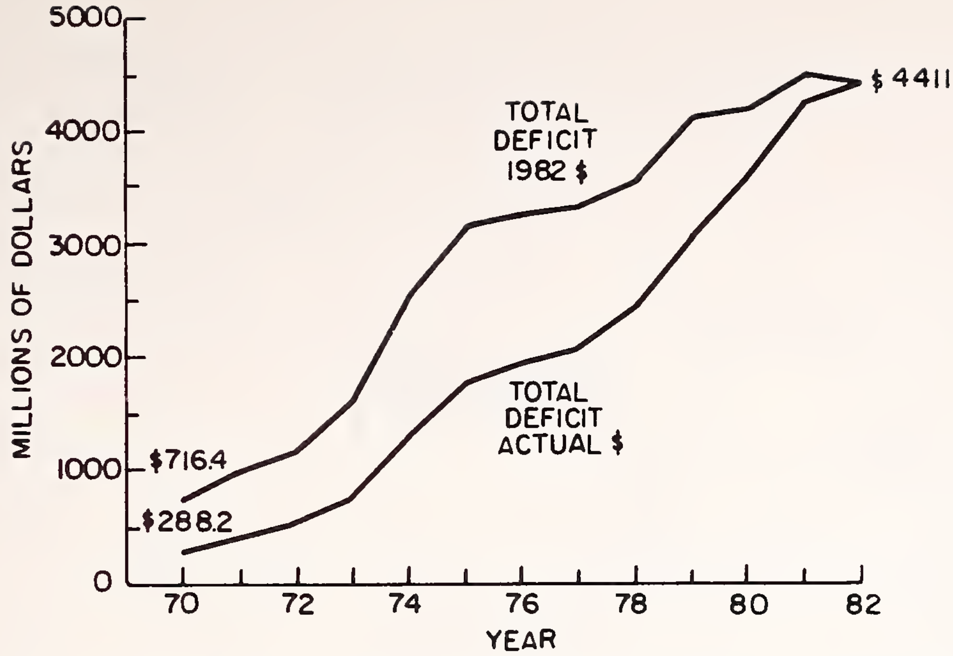

Figure 1.3. Annual Operating Deficit for all U.S. Transit Systems, 1970-1982, in both Actual (Current) Dollars and Constant 1982 Dollars

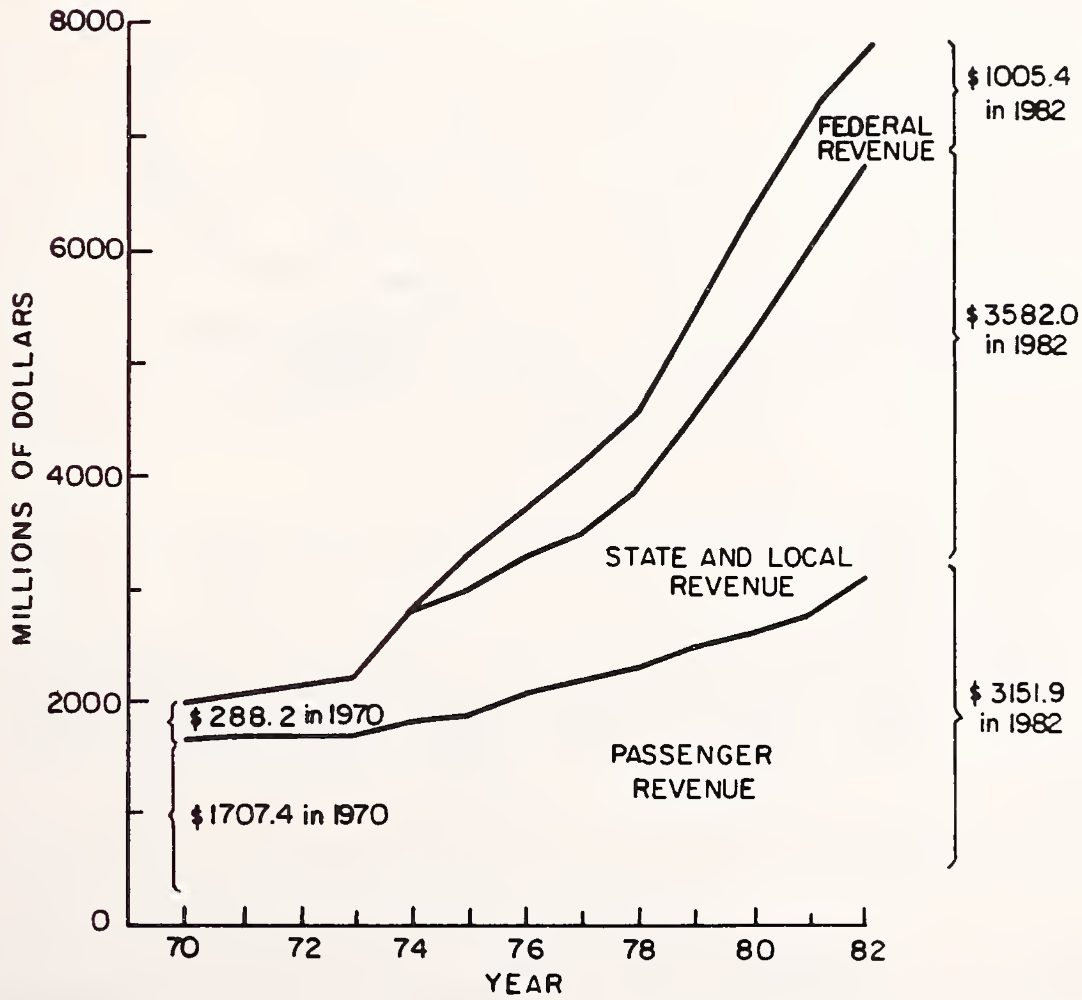

Figure 1.4. Sources of Transit Operating Revenues, 1970-1982, in Actual (Current) Dollars

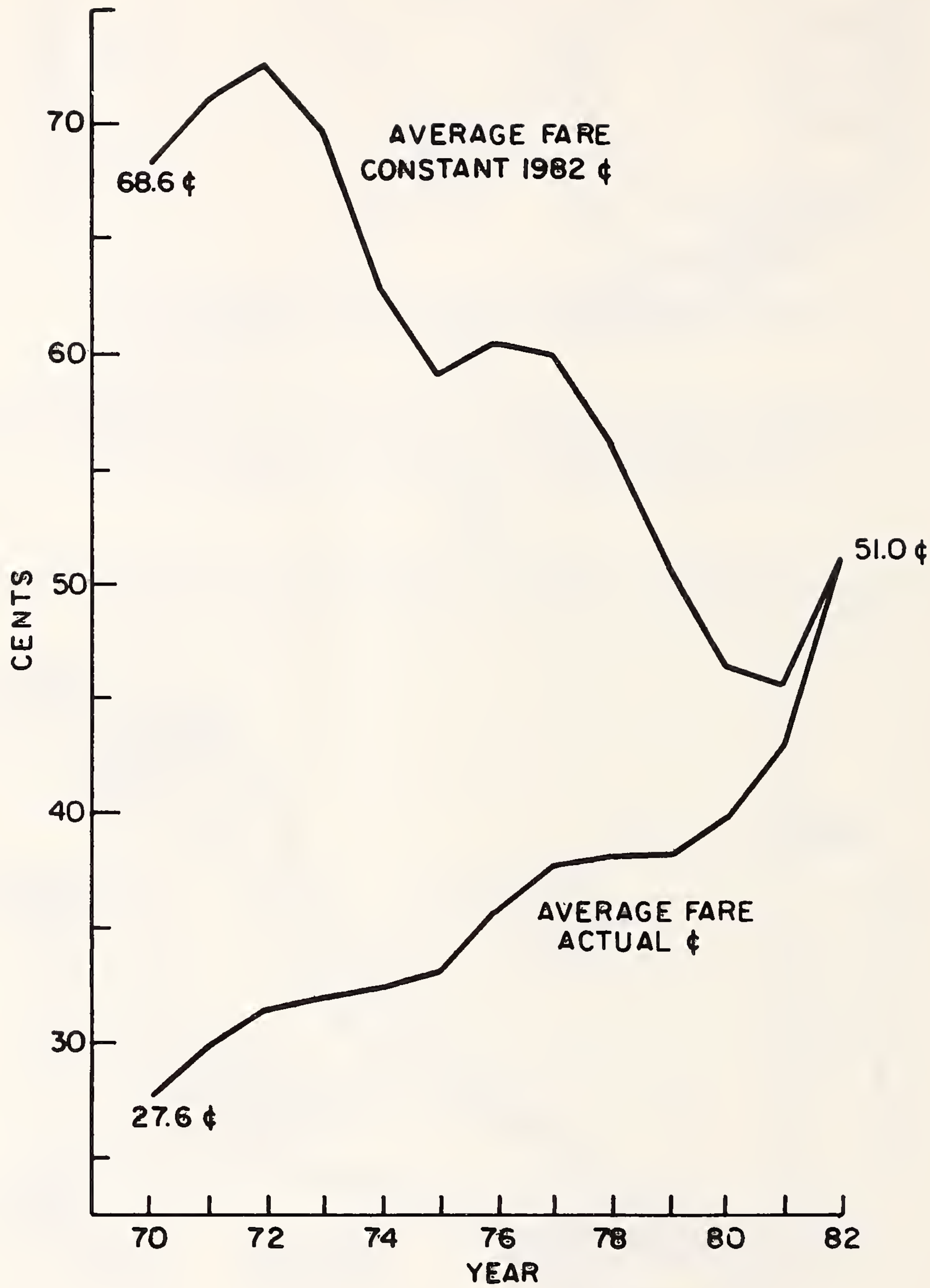

Figure 1.5. Average Fares of all U.S. Transit Systems, 1970-1982, in both Actual (Current) Dollars and Constant 1982 Dollars

costs -- services have been extended into low-density, outlying areas and extra vehicles have been purchased and drivers hired to accommodate rush hour customers. Restrictions on hiring part-time help and union demands for extra pay for split shifts and overtime duties served to increase the costs of peak services even more during this period. Thus, fares which are insensitive to the time-of-day or the distance one travels were popularized at the same time routes were being extended into outlying areas to serve longer trips and rush hour usage was rapidly expanding. Clearly, flat fares have contributed directly to the American transit industry's financial problems.

Besides being inefficient, flat fares are also inequitable. In most cities, longer rush-hour trips tend to be made by higher-income suburban riders, and shorter off-peak trips by poorer inner-city dwellers. Thus, those most able to pay for their trips generally pay the least on a per mile basis. Not only do flat fares benefit the rich at the expense of the poor, but they also potentially deprive certain users the opportunity to even make a trip. Some lower income persons end up foregoing their journeys because they simply cannot afford to pay the cost of their trip plus the cost of cross-subsidizing others. To transit operators, foregone trips translate into lost revenues and empty off-peak buses.

1.2.2 Performance Trends

Rising deficits would perhaps be somewhat palatable were it not for the fact that the industry's productivity declined appreciably over the past decade as well. Despite a massive infusion of government money, nationwide ridership increased only marginally, from 5.93 billion annual trips in 1970 to only slightly more than 6 billion in 1982 (Figure 1.6). Somewhat disturbingly, ridership has actually declined by 400 million annual trips since 1980, reflecting the impacts of a recessionary economy, declining real gas prices and, perhaps, higher transit fares. By almost any measure chosen, the industry's efficiency at producing services also declined steadily. For example, the amount of services provided per employee -- measured in terms of revenue vehicle-miles per worker -- dropped 18% between 1970 and 1982.

The losses incurred in carrying each passenger and traveling a vehicle mile are depicted in Figure 1.7. In constant 1982 dollars, the deficit per rider rose from 12.1 cents in 1970 to 73.1 cents in 1982. The figure reveals that the steepest growth in the per rider deficit was during the mid-seventies, with the rate flattening somewhat since this period. Moreover, the figure shows that the deficit for every mile a transit vehicle traveled rose from 38 cents in 1970 to $2.07 in 1982. Collectively, these trends indicate that, even after removing the effects of inflation, the deficit rate has continued to spiral upwards at an alarming rate. Increased productivity will be necessary in tandem are policy innovations if significant strides are to be made in reversing the industry's decade-long secular decline.

1.2.3 Prospects

There is every reason to believe that the trends of the past

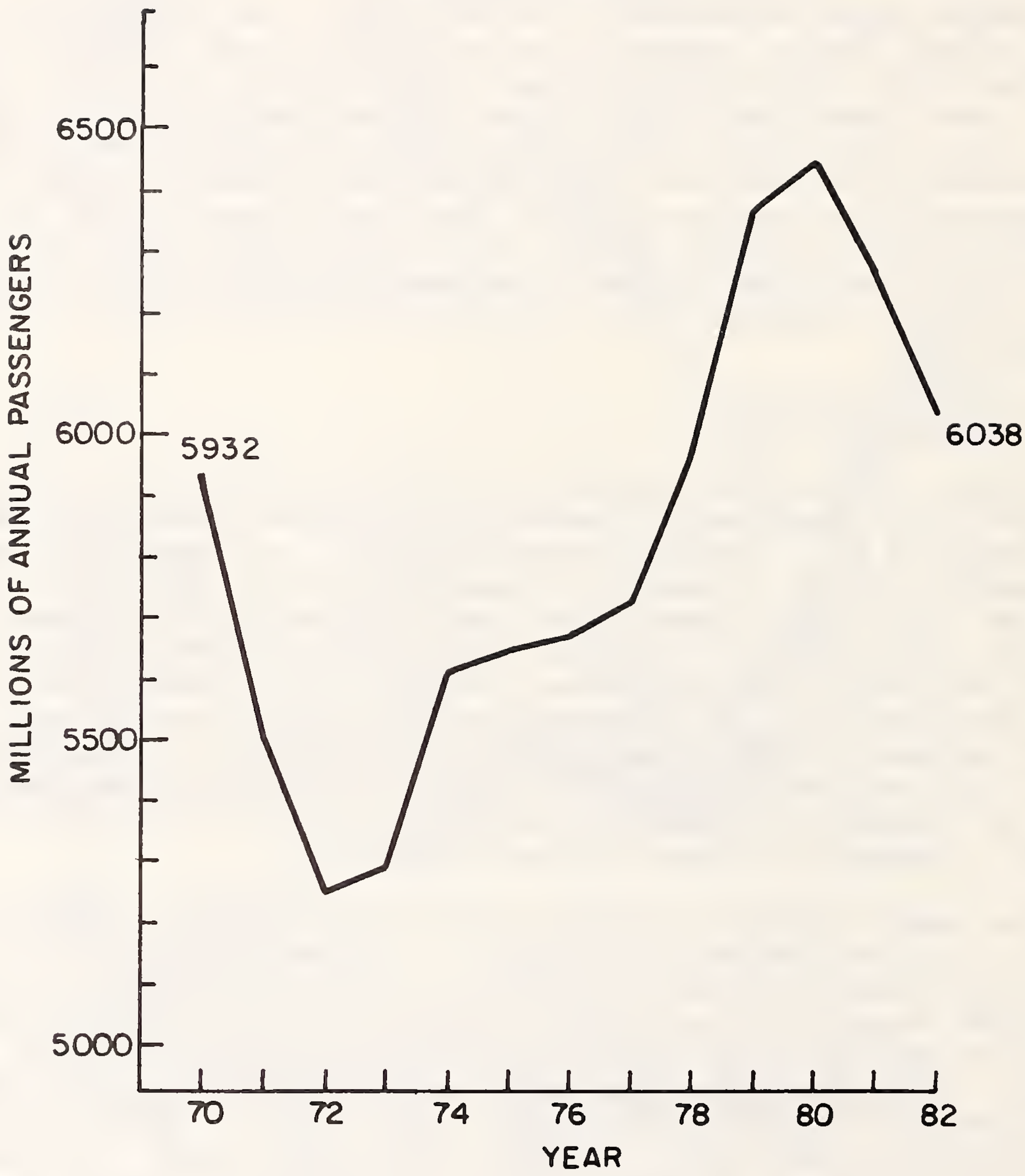

Figure 1.6. Annual Originating Passenger Trips for all U.S. Transit Systems, 1970-1982

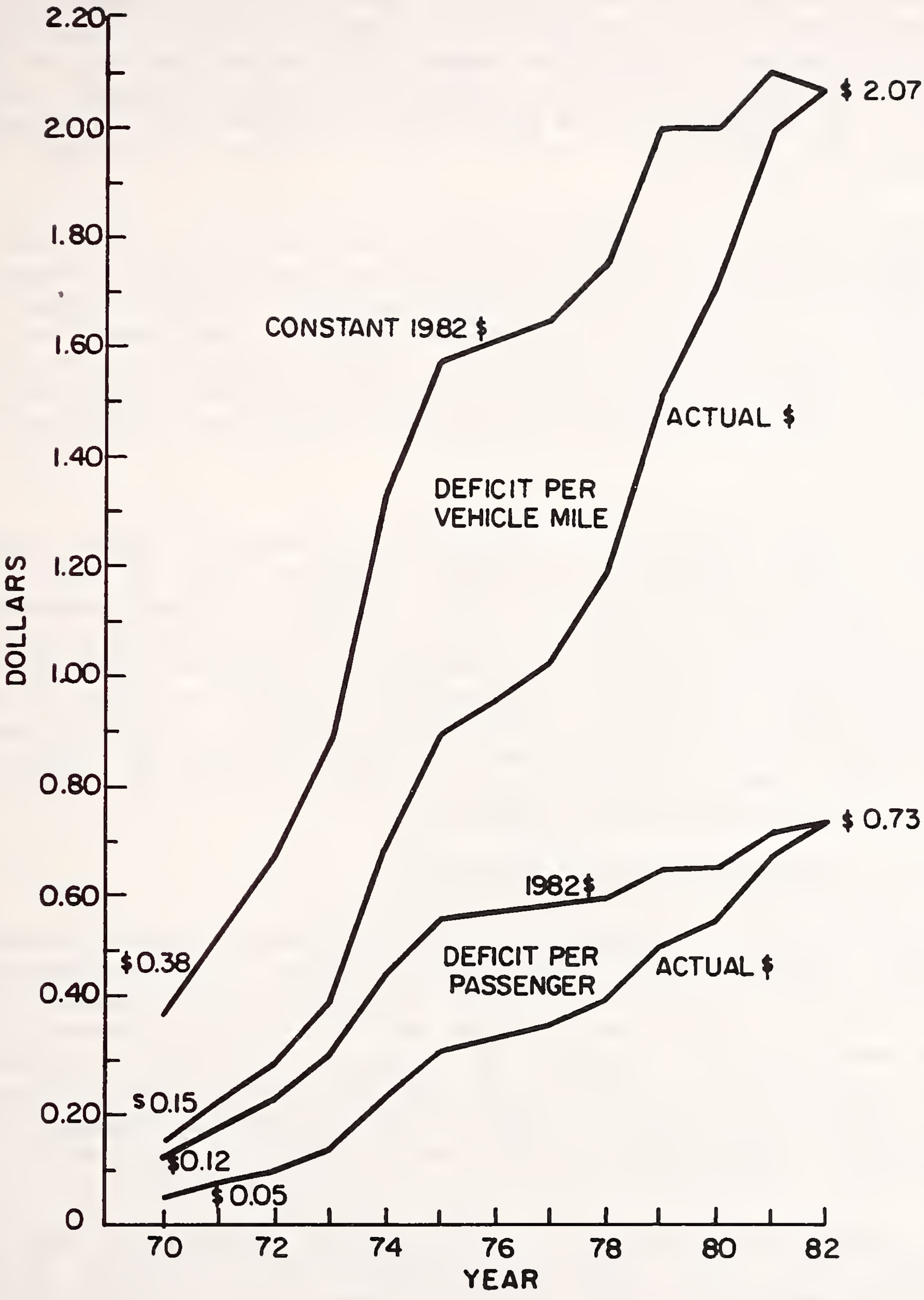

Figure 1.7. Trends in Transit Performance: Changes in Deficit per Vehicle-Mile, and Deficit per Passenger, 1970-1982, in both Actual (Current) Dollars and Constant 1982 Dollars

fifteen years have taken their toll on the American transit industry and that major changes in fare and service practices are the only real recourse. The threatened withdrawal of federal operating support portends drastic service cutbacks coupled with sizable fare increases in some areas, particularly those with limited local and state support. Some properties have even been forced to shut down operations in the face of escalating deficits. Selective service changes, greater use of part-time workers, labor productivity incentives, and various belt-tightening programs obviously are needed. But so are more rational fare policies which promote economic efficiency, the catchphrase of the eighties. The consensus of the September, 1980 Woods Hole Conference on Transit Pricing (UMTA, 1981) was that major changes in current fare practices are imperative:

> Congressional and executive mandates as well as state and local government policies, dating from the era of public take-over of private mass transit systems, have directed transit operators to maximize riderships and to stabilize fares. There are clear signs, however, that many transportation officials feel these objectives are no longer desirable and that others feel that, even if desirable, the objective of maximizing ridership through retention of low fares is no longer feasible.

Conference participants -- represented by industry leaders, transit managers, labor officials, government administrators, and scholars -- sounded a near unanimous call for fare policies in the eighties to reflect the costs of services. As growing numbers of transit properties take steps in this direction, it is imperative that the transportation research community closely study the effects of these new fare programs, and marshall their findings to guide future actions. In this regard, insights into the potential benefits and limitations of time-of-day pricing which recent experiences in the field provide should be exploited to the maximum extent possible.

1.3 Scope of Research and Report Contents

This research concentrates on the evidence which exists regarding time-of-day pricing's impacts in the U.S. to date. Using a comparative framework, experiences from individual case studies are examined, with an eye towards identifying factors which seem most instrumental in bringing about positive ridership and financial outcomes. Particular emphasis is placed on identifying operating environments, service characteristics, and political-institutional settings which appear most amenable to time-of-day pricing. Both individual case analyses and cross-national comparisons are carried out in this pursuit.

The analysis is restricted to urban transit systems in the U.S. which vary adult cash fares during weekdays by time period. Indeed, nearly every American transit property has some form of peak/off-peak differential targetted at other markets. Most, for example, offer concessionary fares to elderly and disabled passengers by providing discounts at non-peak (and sometimes peak as well) periods. Many properties also offer discounts during weekends, effectively representing a

peak/off-peak differential targetted at other markets. Most, for example, offer concessionary fares to elderly and disabled passengers by providing discounts at non-peak (and sometimes peak as well) periods. Many properties also offer discounts during weekends, effectively representing a peak/off-peak fare differential. Perhaps more common are the lower fares enjoyed by regular peak hour commuters through discounted passes as well as special student rates. In these cases, average peak hour fares tend to be even less than those during the off-peak. In that time-of-day fares aimed principally at adult, weekday markets offer more hope for improving the transit industry's financial situation than these other versions, this research focuses on this more limited application.

The report itself consists of nine chapters as well as an extended appendix of individual case studies. Chapter Two develops the concept of time-of-day pricing and reviews empirical evidence on the effects of such fare systems. Arguments for and against time-of-day fares are examined. The third chapter describes the background, structural features, and rationales behind thirty-two time-of-day fare programs in the U.S. which have been implemented since the early seventies. Reasons for abandoning some of these programs are also reviewed.

Chapters Four through Six investigate the full range of ridership, fiscal, productivity, and equity impacts associated with most of the thirty-two time-of-day fare programs. The fourth chapter explores changes in transit ridership following the introduction of both peak period surcharges and off-peak discount programs. In the cases of eight systems for which suitable time series data were available, fare elasticity estimates are presented for both peak and off-peak ridership segments. Some effort is also made to trace the level of ridership shifts between time periods, although information on the incidence of shifting is largely anecdotal. Chapter Five concentrates on the financial and productivity trends associated with the assortment of time-of-day pricing programs which have emerged. Emphasis is placed on tracing changes in cost recovery rates and various indicators of productivity by studying changes in ridership compositions using such variables as users' ages, incomes, ethnic backgrounds, and levels of transit dependency. Data from six transit properties which performed on-board ridership surveys both before and after the introduction of time-of-day fares are employed in exploring the equity issue.

Chapter Seven of the report looks at the full range of issues involved in implementing time-of-day fares -- strategies pursued in collecting, marketing, and maintaining them. Approaches towards dealing with the time-border problem and potential driver-user confrontations are given particular attention, as are the reactions of various groups -- riders, drivers, and board members -- to these fare reforms. Chapter Eight strives to highlight the political and institutional issues surrounding time-of-day fare programs by carrying out more in-depth case reviews using experiences in Cincinnati, Columbus, and Washington, D.C.

The final chapter summarizes the report's findings and presents recommendations. Conditions under which time-of-day pricing appears most promising are emphasized.

Thirty-two individual case studies from which the report's contents were derived can be found in Appendix I of the companion volume (Evidence on Time-of-Day Transit Pricing in the United States: Case Summaries and Appendices). For each case summary, the following information is provided: system description; fare structure; reasons for adopting (or discontinuing) time-of-day pricing; trends and impacts associated with time-of-day prospects. Case summaries provide the interested reader with more details into the particular issues and findings of individual transit properties than can be found in the body of the report.

Chapter Two

Time-of-Day Transit Pricing: Theory and Practice

2.1 The Concept of Time-of-Day Pricing

The economic rationale for indexing transit fares by time-of-day is fairly straightforward -- it costs more to produce peak hour services, so prices should consequently be higher during those periods. The idea is to incorporate into the fare structure the extra cost of scaling operations to handle rush-hour loads as well as the labor cost penalties of paying drivers higher rates for split shift and extra time duties.

Time-of-day fares are considered to be more efficient than uniform ones because they link prices to the additional costs of providing expanded peak services. If fares fall markedly below these added costs, then over-consumption will result as riders take advantage of the under-priced "good". However, if peak and off-peak users alike pay the same portion of their trip costs, then no particular type of rider will be more likely to travel because of an unfair price advantage.

Fundamentally, arguments for pricing services according to time-of-day are grounded in the belief that public transit shares certain characteristics common to public utilities -- namely, inherent economies of scale and fluctuating levels of demand. They have formally evolved from a body of theory referred to as peak-load pricing. To the extent public transit takes on properties of a natural monopoly, price differentiation becomes necessary as a means of fully recovering costs and efficiently allocating labor and capital. Some doubt remains, however, whether transit enjoys increasing returns to scale, and thus whether traditional peak load pricing concepts are applicable. Recent studies have found both increasing and decreasing returns to scale, depending upon the output measures adopted (e.g., cost per passenger versus cost per vehicle mile) and the size of property studied (Williams and Dalal, 1980; Viton, 1981; Berechman, 1982).* Unit cost variations between peak and off-peak periods have been estimated to be as small as 10% and as large as 200% (Reilly, 1977; Cherwony and Mundle, 1978; Mohring, 1972; Waggon and Baggaley, 1975). Differences in marginal, or extra, costs have been estimated to be even greater. One cross-sectional study of British bus systems estimated marginal costs in the peak to be 3.5 times as high as those in the off-peak (Wabe and Coles, 1975).

For most U.S. transit systems, unit costs, such as operating expense per vehicle hour, are relatively high during both the morning

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* Units of output can either be defined in terms of services deployed or service consumed. The former, such as cost per vehicle hour, often results in estimates of decreasing returns in large cities while measures such as cost per passenger often will show the converse. Since larger bus systems tend to operate under conditions of greater surface street congestion and stronger union pressures on driver wages, some incidences of diseconomies of scale probably exist in major cities.

and evening peak periods and the lowest during midday (inter-peak) hours. On an expense per passenger-mile basis, however, unit costs between these periods can be quite similar due to high rush-hour load factors. Since transit properties' balance sheets tend to reflect costs more in terms of services deployed as opposed to those consumed, however, measures such as expense per vehicle mile or hour are probably more appropriate for expressing time-of-day cost differences. Perhaps the highest unit costs (measured in terms of both service consumption and service deployment) are during late-evening and weekend periods when premium pay rates apply, loads are relatively small, and additional expenses are more avoidable.

High unit costs during peak periods stem directly from the diurnal nature of transit demand -- surges in ridership during the morning and evening rush hours require transit systems to scale and staff their operations for two limited periods of the day. The fact that peak demands are spread between two different points in time, separated by a "dead period", is what's so costly. For most systems, work rule restrictions require the full manning of services over a twelve to fourteen hour period of time, even though demand might only warrant full deployment of services for five or six hours. Labor contracts which require spreadtime premiums and guarenteed pay and which prohibit the hiring of part-time help have exacerbated the cost impacts of peak period services. The cost effects of work rule restrictions and pay premiums have been particularly perverse in areas with high peak-to-base ratios of demand (and consequently service deployment). Since drivers are readily available for carrying out work during the inter-peak and thus extra costs are negligible, many have argued for a lowering of midday fares in tandem with an increase in peak period ones to reflect true incremental cost differences (Mohring, 1970; Cervero, 1980; White, 1981).

In sum, peak/off-peak fare differentials aim to pass the extra costs of scaling transit's infrastructure to serve rush-hour loads and expanding services into often less productive outlying markets onto the peak hour user. The interested reader is referred to Appendix II for a more detailed discussion of the theoretical arguments for applying peak load pricing rationales to public transit.

2.2 Types of Peak/Off-Peak Fare Programs

An assortment of terms are currently used to describe how transit fares can be varied between peak and off-peak periods. Perhaps the most generic term is peak/off-peak pricing, referring to the variation of fares between high demand and base, or low, demand periods. Peak/off-peak fares, can involve charging different rates during rush-hour and non-rush periods of the day, between weekdays and weekends, or even over different seasons of the year. Thus, at least three versions of peak/off-peak pricing are time-of-day fares, day-of-week fares, and seasonal fares.

This research concentrates solely on peak/off-peak fares which vary by hours of the weekday, i.e., time-of-day pricing, primarily because this represents the most significant form of differential in terms of efficiency potential. A number of American transit properties do offer weekend fare breaks, even though the average costs of these services are probably even higher than those during weekday rush hours. In that some residents are highly dependent upon weekend services while a large

number of others are quite sensitive to Saturday and Sunday transit prices, charging a higher fare for these periods would probably be counterproductive. Seasonal fares, however, might be appropriate where significant cost increases are incurred over several months of the year, as in the case of, say, a summer resort area.

With regards to time-of-day pricing, a number of variations can be identified. These are defined below and summarized in Figure 2.1 in terms of changes from the base, or average, fare level:

1. Peak Surcharge -- when fares are increased only during morning and evening peak hours, and fares at all other times remain at the base level.

2. Non-Midday Surcharge -- when fares are increased for all hours of the day except during the midday period.

3. Off-Peak Discount -- when fares for non-peak periods, such as the early morning, midday, and late evening, are lowered from the base charge and base fares apply only to peak periods. The most prevalent form is a midday discount.

4. Differential Increase -- when fares are increased in both periods, however peak fares rise more than off-peak ones.

5. Differential Decrease -- when fares are lowered in both periods, however more so in the off-peak than peak.

6. Peak/Off-Peak Separation (Peak Surcharge/Off-Peak Discount) -- when fares are increased during peak hours and lowered during the off-peak.

7. Off-Peak Pass -- a discounted pre-paid pass only for use during off-peak periods.

8. Peak Pass -- a discounted pre-paid pass only for use during peak periods.

9. Pass/Surcharge -- a discounted pre-paid pass good only for off-peak period use, or peak period use if accompanied by a surcharge.

Over ten U.S. transit properties introduced peak surcharges since 1970, increasing fares only during morning and evening rush hours. At least one instance of a non-midday surcharge, whereby fares were raised for all periods of the day, except during the inter-peak, has been recorded. A non-midday surcharge aims not only to capture the high incremental costs of peak period services, but to offset the premium salaries paid for evening and late-night services as well.

A number of discount possibilities also exist for differentiating fares by time-of-day. The most common has been midday discounts, where fares between peak periods are lowered in hopes of filling up empty bus seats. The discount arrangement can also be extended to early morning, late evening, and weekend periods, and combinations thereof.

Rather than the fare change being one-sided, over ten American properties have inaugurated time-of-day pricing by increasing fares at

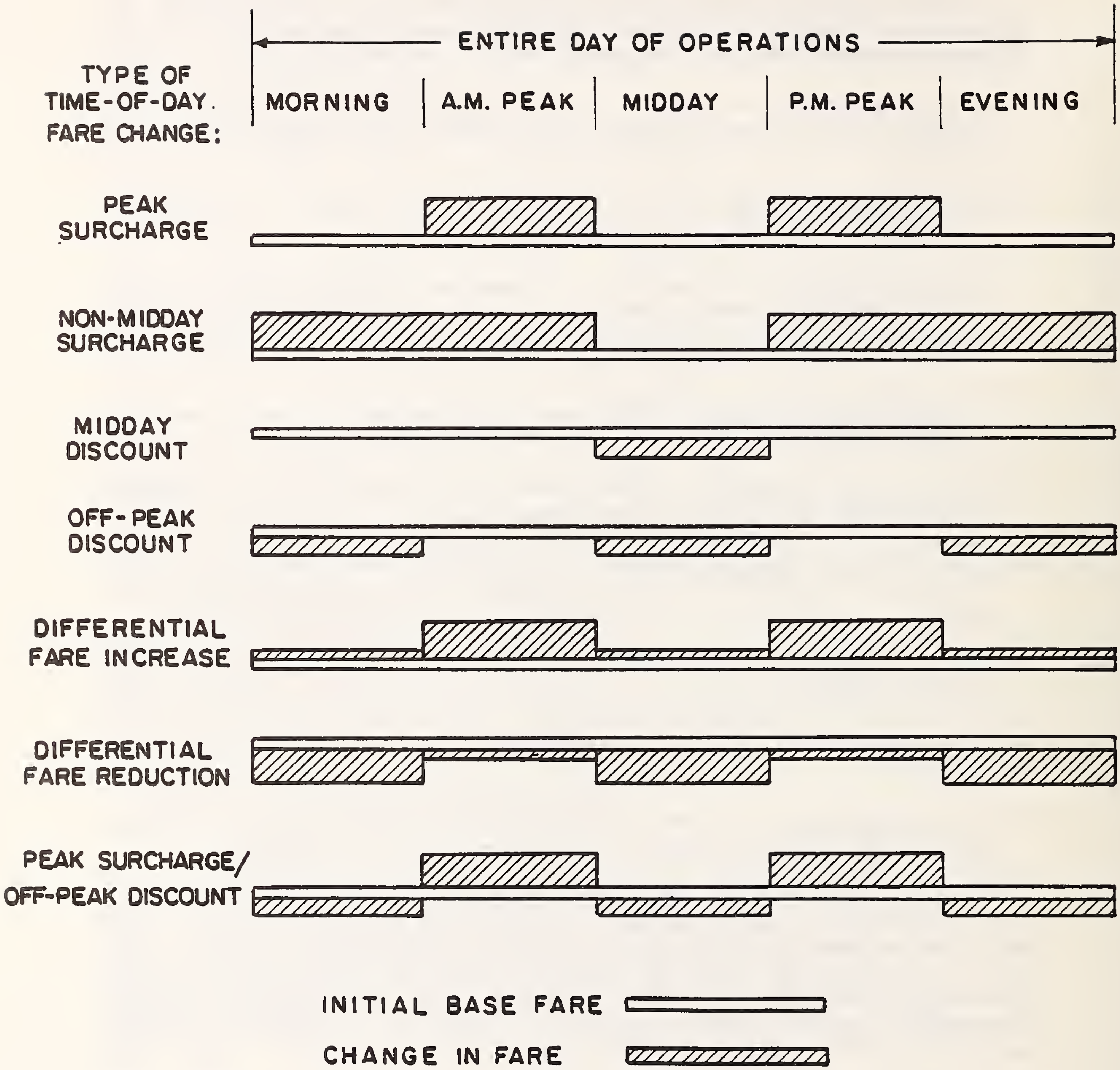

Figure 2.1. Time-of-Day Pricing Options: Ways of Varying Fares from the Base Level

different rates during the peak and off-peak. Although a differential increase effectively results in a higher peak versus off-peak fare, this approach implies different ridership and financial impacts than other options because base fares are increased at all times. The differential change can also be in the other direction, involving decreasing off-peak rates faster than peak ones, although there have been no instances of this. Neither have there been any cases of a combined peak surcharge/off-peak discount -- i.e., a raising of peak period fares coupled with a lowering of off-peak ones.

Finally, several pass possibilities exist for differentiating fares throughout the day. At least three American cities have implemented pre-paid passes sold at a discount which are restricted to off-peak usage. There are no U.S. examples whereby passes can be used only during peak hours, although the existence of discounted express service-only passes in a number of cities has effectively resulted in lower rush hour commuting costs. Another possibility is to allow peak period passengers to use discounted off-peak passes plus pay an add-on fare. No cases of a Pass/Surcharge arrangement have been recorded either, although Bridgeport and Pittsburgh have implemented discounted passes which require surcharges, however in all periods (Oram, 1983).*

These versions of time-of-day pricing by no means exhaust the possibilities. White (1981), for instance, argues that an asymmetrical peak surcharge arrangement should be considered. In England, he notes, the morning hours tend to be more peaked than the afternoon due to the inter-mixing of school and work trips. Accordingly, he raises the possibility of limiting peak surcharges to morning rush hours. A morning-only surcharge might also reduce the incidence of early-afternoon shoppers paying extra as well as eliminate fare disputes at the afternoon time-break. Some places might experience greater afternoon peaking, however, due to heavy inter-mixing of shop and work trips, in addition to the existence of common departure times for work-to-home trips (e.g., a factory setting). A higher afternoon fare might be considered in the instance. Tyson (1975) also notes that the mini-peak during lunchtime hours could call for adding a third surcharge period. It is probably the case, however, that the differentiation of fares between morning and afternoon peaks, or the adding of a midday mini-peak surcharge, would not be worth extra effort.

It should also be noted that time-of-day fare differentials currently exist in almost every American city for special ridership markets, namely elderly, handicapped, student, and regular-commute passengers. Section 16 (b)2 of the amended 1964 Urban Mass Transportation Act mandates that transit systems charge elderly customers fares no more than one-half of the base rate during off-peak periods as a precondition to the receipt of federal assistance. Most properties have extended this discount to handicapped passenger as well. Many have even extended the half-fare provision to all hours of the day. Student cash or pass discounts are also usually offerred in recognition of teenagers' and pre-teens' transit-dependency, even though these groups often ride during limited-capacity peak periods. Monthly unlimited-ride passes, often priced at forty times the base period fare yet used upwards of

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* The programs aimed to increase revenue returns and reduce pass-related abuses.

sixty time per month, also end up providing regular, usually peak period, users with a discount.

Given the prevalence of student discounts and pass programs in the U.S., it is probably the case that average peak period fares are actually lower than those in the off-peak, at least among non-elderly markets. White (1981) suggests that the discontinuation of concessionary student fares would probably eliminate the need to differentiate fares by time-of-day in England's adult transit market. In any event, time-of-day pricing effectively exists in most American cities by virtue of the sizable discounts offerred to predominantly rush-hour pass users.

2.3 Reviewing the Pros and Cons of Time-of-Day Pricing

In addition to efficiency arguments presented in section 2.1, other rationales have been offerred for differentiating transit fares by time-of-day. This section summarizes various arguments which have surfaced over time both for and against peak/off-peak transit pricing. Table 2.1 summarizes these pros and cons.

2.3.1 Arguments for Time-of-Day Pricing

Increase Ridership and Farebox Revenues

An oft-cited reason for varying fares by time-of-day is that net increases in ridership and farebox revenues would result. This is because peak hour commuters have historically been shown to be less sensitive to fare changes than non-peak travellers. Those commuting by bus or rail during rush hours are generally locked into a particular work schedule and have less discretion as to when they travel. From a comprehensive survey of the literature, Lago and Mayworm (1981) found an average peak fare elasticity for American properties of -.21 compared to -.48 for off-peak passengers. Higher charges assessed against peak users, therefore, would be expected to yield net revenue gains while any lowering of off-peak fares would likely induce an overall increase in patronage.

Of course, ridership and revenue impacts could be expected to vary by the size of the differential, the sensitivity of users to prices changes, and the type of time-of-day fare program implemented. Table 2.2 summarizes the trade-offs involved in a hypothetical setting where: peak surcharges and off-peak discounts are introduced; daily ridership is evenly distributed between peak and off-peak periods; and fare elasticities are in the range presented by Lago and Mayworm's work (1981). Under a peak surcharge arrangement, one would generally expect a small decline in overall patronage combined with a relatively larger increase in farebox receipts. An off-peak discount, on the hand, could be expected to increase overall ridership (with the net gain depending upon the level of shifting from the peak to off-peak hours), at the expense however of a decline in total revenues. Lastly, the peak surcharge/off-peak discount arrangement would combine the benefits of both components -- higher ridership and higher revenue returns. In general, as demand becomes more elastic (at the same rate) in both peak and off-peak periods, the relative revenue gains of peak surcharges would decline while the relative ridership gains of off-peak discounts would increase.

Table 2.1
Time-of-Day Transit Pricing --
Benefits and Barriers

Potential Benefits:	Potential Costs and Impediments:
* Increased Ridership - Net gains in ridership - More equal distribution of trips by time period	* User Resistance - Protests over increased complexities - Perceived barrier to transit usage
* Net Revenue Gains	* Driver Resistance - Complicated work duties - Increased chance of fare disputes and passenger confrontations - union pressures for higher wages
* Efficiency, Service Quality, and Cost Improvements - Reduced peak/base ratio of vehicles and work assignments - Increase non-peak load factor - Fewer passenger standees - Faster speeds and better Schedule Adherence	* Political Resistance - Resentment over fare penalties for peak usage - Protests and pressures from suburban and working class residents
* Equity Benefits - Reduce cross-subsidies - Attract latent demand - Reduce average trip cost to many lower income users	* Varying Cost Perceptions - Belief that commute-period services are money-makers
* Secondary Benefits - Stimulate downtown retail activities - Support central city revitalization efforts - Improve transit agency's public image as an innovator	* Increase Transactive Cost - Higher fare collection expenses - Marketing, educational, and training expenses - Increased fare abuse
	* Service Deterioration - Fare confusion slows boarding

The fact that no American transit properties have implemented a true peak surcharge/off-peak discount program to date suggests that the ridership and financial impacts of past and existing time-of-day fare programs have probably been mixed. This is examined in Chapters Four and Five. Indeed, White (1981) notes that most time-of-day fare experiments in Great Britain have been recorded as "failures", despite their abilities to reflect cost differences, because of the respective drawbacks of an off-peak discount or a peak-only surcharge. The reason why no American properties have simultaneously raised peak fares while lowering off-peak ones speaks directly to the political and institutional obstacles discussed below and in Chapters Seven and Eight.

Efficiency, Service Quality, and Cost Improvements

Time-of-day fares could also be expected to improve operating efficiency by more evenly distributing ridership throughout the day. The scale of peak operations could thus be reduced due to shifts in ridership to the lower-priced off-peak periods. Not only would costs be reduced, then, but available off-peak capacity would be more fully utilized. Moreover, service quality would improve during peak periods since over-crowding would be relieved. Reducing "crush" loads would probably increase speeds and improve schedule adherence since less dwell time would be spent boarding and unloading passengers. Conversely, the redeployment of some runs to midday periods could upgrade off-peak services via reductions in headways.

Table 2.2
Expected Direction of Ridership and Revenue Impacts of Time-of-Day Pricing Options*

Type of Differential:	Expected Impact on: Ridership	Revenues
Peak Surcharge	Decrease	Increase
Off-Peak Discount	Increase	Decrease
Peak Surcharge/ Off-Peak Discount	Increase	Increase

* Where overall demand is price-insensitive, elasticities during the peak are one-half as small as during the off-peak, and ridership is evenly split between peak and off-peak hours.

Equity Benefits

Time-of-day transit fares have also been touted for their potential abilities to remove some of the inequities associated with flat fares. Since peak and off-peak users alike would be covering equal shares of their trip costs, any cross-subsidies between groups would be eliminated. Also, rush hour commuters generally can afford higher fares more so than the average user since the fact they're making work trips indicates they're employed. In addition, more affluent suburbanites who tend to travel during rush hours would end up paying more per mile under a peak surcharge program while inner-city residents making off-peak trips would benefit from off-peak discounts. The latent demand attracted to transit under time-of-day pricing, moreover, would likely consist of primarily lower income persons -- those who previously had to forego their travel because they couldn't afford to pay the cost of a base-period trip plus some of the cost of serving peak period users.

Secondary Benefits

Time-of-day fares might also serve to stimulate downtown shopping activities during off-peak hours in some cities. Coupled with other development incentives, an off-peak discount program could be part of an

overall downtown revitalization effort. Time-of-day differentials might also spawn the initiation of flex-time and staggered work programs among employers concerned about workers' commuting costs. Off-peak discounts can also improve a transit agency's public image and strengthen its ties with an area's business community.

2.3.2 Arguments and Impediments Against Time-of-Day Pricing

User Resistance

The benefits of time-of-day fares are countered by several major barriers and costs associated with implementing them. Foremost are the various political and institutional impediments to changing the current simple and somewhat established practice of uniform pricing. Users eschew anything which complicates the process of making a trip, including a more complex pricing structure. A time-of-day differential might be perceived as an obstacle to riding transit, although alternative forms of cost-based pricing, such as zonal fares, are apt to be even more confusing. Some also note that the vast majority of patrons make the same trip regularly and would thus have few problems with differential fares. Perhaps the greatest user resistance could be expected in those areas which augment zonal fares and alternative pass and ticket programs with time-of-day differentials, producing a highly complex rate structure as a result. For all of these reasons, White (1983) reports that the simplicity advantages of flat fares have prompted some British transit systems to changeover to uniform pricing at the very time when American properties are seriously considering more differentiated structures.

Driver Resistance

Time-of-day fares would also complicate driving duties and possibly involve operators in the enforcement of proper fare payment. Drivers could also be expected to bear the burden of explaining the fare structure to riders and settling disputes over what price should be paid. Driver-user confrontations might be expected at the break points between peak and off-peak periods as riders attempt to cash in on the lower fare. Additional job pressures could lead to driver morale problems as well as increased absenteeism. Union opposition to time-of-day pricing might therefore be expected, along with demands for higher pay commensurate with expanded work duties.

Political Resistance

Any structural change in pricing could be expected to cause a certain amount of political resistance. Transit officials must answer to the public and negotiate with driver representatives, so concerns over complexity could stonewall any time-of-day fare proposal. Other arguments might provide additional political ammunition against time-of-day pricing. Resentment towards paying higher fare rates during peak hours might come from suburban commuters who feel penalized for choosing public transit over auto travel. Indeed, charging transit commuters more might be inequitable and counterproductive if rush hour motorists fail to pay the marginal costs of highway use. Some have argued that transit commuters should receive substantial breaks since their automobile compatriots fail to cover their true trip costs (Sherman, 1971; Glaister and Lewis, 1978). Protests might also be heard from suburban residents

who resent paying more at the farebox while also paying relatively higher taxes to support the transit district. Moreover, working class citizens, who constitute transit's bread-and-butter users, might resent being sacked with higher peak fares at a time when real incomes are declining. Additionally, in that rush hour passengers generally experience crowded, less comfortable conditions, a premium surcharge for what some consider to be inferior quality service could be viewed as rubbing salt in the wound. In sum, peak hour passengers form an important political constituency which could thwart any effort to differentiate fares by time of day.

Differences in Perceptions of Costs

There is a common perception that peak services are money-makers while non-peak ones are money-losers. Thus, charging peak users more seems illogical to many policymakers and riders. The common spectacle of elbow-room-only peak buses and half-empty off-peak ones understandably causes some to presume that rush-hour services bring in the profits. Most citizens fail to acknowledge the true cost impacts of manning a bus system to cover two daily peaks, particularly those related to spreadtime pay premiums. Convincing even board members that it costs more to serve rush hour customers can be difficult. In comparison, the economic rationale behind distance-based fares is intuitive. Everyone understands that it costs more to run a bus ten miles than five miles. Thus, differing perceptions about what it costs to operate peak services can impede time-of-day pricing programs.

Increased Transactive Costs

The costs and logistics of collecting time-of-day fares can also pose significant barriers. In contrast to finely graduated fares, peak/off-peak differentials do not require investments in automated fare equipment, such as on-board ticket dispensers and validators. The fact that usually only two different fare rates apply is a major advantage of time-of-day fares. Still, higher transactive costs related to marketing and promotion, user education, and driver training would be incurred if a property introduced time-of-day pricing. Additional expenses for signage and revising schedule brochures might also be expected.

Perhaps one of the major obstacles to implementing time-of-day fares is the boundary, or time-border, problem of when exactly to collect higher rates. Though the time break from the peak to off-peak may be at 9:30 a.m., for all intensive purposes it costs no more to carry someone at 9:28 than 9:32. Such a rigid boundary can pose inequities and invite confrontations between users and drivers. This collection approach is time-based in that fares change exactly according to the clock. Perhaps a more reasonable alternative, from both a cost differential and implementation standpoint, is run-based or direction-based collection. Here, off-peak fares on each route are collected only at the beginning of the first run outside of the peak period. This is typically the backhaul, outbound run in the late-morning after most a.m. passengers have been dropped off downtown and the inbound run in the late-afternoon after most p.m. passengers have returned home. This collection approach might be particularly well-suited to predominantly radial transit systems where directional splits are high. The principal advantage of run-based collection is that fares change only when a new group of passengers board the bus rather than midway along a route.

Various approaches being used to collect time-of-day fares are discussed in more detail in Chapter Seven.

Finally, as fares become more complicated, the opportunities for evasion might increase since full enforcement becomes all the more difficult. Cheating can cause resentment among honest customers and rob an agency of vital income.

Service Deterioration

Related to the complexities which time-of-day fares might impose is the possible deterioration in service quality. In particular, confusion over fares and disputes between drivers and passengers can slow buses down and disrupt schedules. Gains enjoyed by riders at the farebox therefore might be offset by losses due to poorer service quality.

2.3.3 Weighing the Arguments

The choice between time-of-day or uniform fares as a preferred pricing system implicitly reflects how different policymakers view the benefits and costs summarized above. The fact that most transit systems in the U.S. today still rely on flat fares suggests that many officials consider the benefits of time-of-day fares to be insufficient to make up for the "hassle" factors. Yet the fact that new time-of-day fare programs are being introduced yearly indicates that in certain settings they're still considered attractive. The following chapters attempt to sort through the competing arguments for and against time-of-day pricing by studying experiences in the field. As a prelude to this, Section 2.4 briefly reviews current insights into the benefits and costs of time-of-day fare programs.

2.4 Literature Review: What We Know About Time-of-Day Fares

2.4.1 Ridership Impacts

Past studies have consistently found ridership responses to fare changes to be greater among off-peak than peak period users. In cities such as New York and London, off-peak elasticities are 2.5 times larger than corresponding peak period values (Mayworm, et al., 1980; Lassow, 1968). Differences in fare elasticities between time periods have been found to be only slightly less for smaller cities (Kemp, 1973). These variations are almost entirely a function of differences in elasticities among trip purposes -- on average, work trip elasticities are -.17 compared to -.40 for non-work trip ones (Mayworm, et al., 1980). Amongst ridership groups, captive users, such as the poor, are generally willing to tolerate the greatest percent change in their fares, though there is some evidence that such groups are most likely to shift their travel between time periods (Billingsley and Cureman, 1980).

Most of the work on measuring fare elasticities between time periods has been based upon across-the-board fare adjustments rather than actual time-of-day differentials. Several British studies (Tyson, 1975; Tebb, 1978) did find higher elasticities for off-peak discounts than for peak period surcharges, however there was generally little evidence of shifts between time periods. Some researchers have estimated that 30-50% differentials in fares are necessary to encourage significant inter-temporal shifts to the off-peak (Habib, et al., 1978). On

the whole, evidence on time-of-day cross-elasticities is scarce. Most observers feel cross-elasticities are probably fairly low since workers often have little choice in deciding home-to-work travel periods.

Some evidence on the ridership effects of reduced off-peak fares is provided by the 1978 free fare demonstration programs in Trenton and Denver (Doxsey and Spear, 1981). Immediately following the introduction of free off-peak services, midday and evening ridership rose 46% in Trenton and 52% in Denver. Throughout the trial year of free fares, these ridership gains were sustained. Following the reinstitution of fares in 1979, ridership remained above pre-demonstration levels, even after accounting for 2-2.5% secular growth. Transit-dependent users, however, were generally less responsive to the free fare incentive than other segments of the population, casting some doubt on the purported redistributive benefits of lower off-peak fares.

It's important to note that most empirical work to date has measured only short run responses to fare changes, and that longer term elasticities are likely greater as a wider range of transportation and locational choices become available over time (Pucher and Rothenberg, 1976). Only time will tell the longer term implications of transit fare reforms. Chapter Four of this report augments our current insights into the ridership effects of time-of-day pricing by presenting a range of fare elasticity estimates for American systems which have introduced time-of-day pricing since the early seventies.

2.4.2 Revenue and Cost Impacts

The literature is generally inconclusive about the revenue and cost implications of time-of-day pricing. In general, fiscal impacts depend upon the specific type of differential program introduced and the associated price elasticity of demand. One study by Wilbur Smith and Associates (1978) concluded that:

> Efforts at providing peak/off-peak fare differentials for all users on a sustained basis has been tried on a number of situations and subsequently withdrawn. The reason for discontinuance has been that the reduction in midday fare revenue was more than the amount recovered from individual riders.

Elsewhere in the literature, however, positive revenue impacts of fare differential can be found, particular with regards to peak surcharge programs (Mayworm, et al., 1980; Tyson, 1975).

Evidence on the cost impacts of time-of-day pricing is fairly sparse. Habib et al. (1978) estimated that, on average, a .5% reduction in annual operating expenses could be realized for every 1% reduction in peak vehicles allowed by a fare differential. However, Tyson (1975) found the level of trip diversion to the off-peak to be too small to have had any significant impact on Manchester's operating costs. When the additional administrative and training costs of collecting differential fares are considered, unit operating costs may actually increase. Any wage increases prompted by differentiated fares to compensate drivers for expanded duties could also materially increase costs.

A recent simulation study (Cervero, 1982) took these factors into account, and estimated that peak/off-peak fare differentials of 50-70%

in Los Angeles, Oakland, and San Diego would improve each property's fiscal performance. Total annual costs under these fare schemes were projected to increase by between 1.5%-2.5%, however passenger revenues were estimated to increase even more -- 3%-13.5%. In Los Angeles, it was estimated that farebox recovery rates* would likely increase from 40% to 53% under a 55 cents/25 cents differential. Though time-of-day fares appeared less revenue productive than distance-based pricing in the analysis, when their lower collection costs were considered, their overall financial performance was on a par with graduated pricing.

Overall, evidence on the financial impacts of time-of-day pricing is fairly incomplete and inconclusive. Chapter Five of this report attempts to augment what we know in this regard.

2.4.3 Equity Impacts

Inequities in transit pricing have received considerable research attention in recent years. In Albany, midday users' fares were found to be 7 cents higher than the fare rates paid by morning and evening riders (Leutze and Ugolik, 1979). My own work found that 56% of off-peak service costs were being recovered in Los Angeles in 1979 compared with a recovery rate of only 37% for rush hour services (Cervero, 1981). In absolute terms, it was estimated that the transit district lost 63 cents for every rush hour passenger served compared to 37 cents for every non-peak customer carried. Disparities in recovery rates were similar in both Oakland and San Diego.

Many observers believe that these cross-subsidies are regressive in incidence and generally hurt those most dependent upon transit. Using data from the 1978 National Passenger Transportation Study, Pucher (1981) found that 20% of peak-hour bus riders had annual incomes of $6,000 or less compared to 34% among off-peak riders. My analysis of the three California properties found cross-subsidies to be only mildly regressive (Cervero, 1981). Although higher income patrons generally netted the greatest benefits under flat fares, there were nonetheless substantial numbers of low income persons reverse commuting during rush hour as well as higher income passengers riding short distances during the midday. On the whole, flat fares were found to hurt users without auto access, females, non-whites, young adults, and non-worker tripmakers the most. However, distributional impacts did vary among operators, and some of the differences in cost recovery were quite small when broken down by passenger socioeconomic characteristics.

The simulation of peak/off-peak pricing in the three Californian cities suggested that maldistributive effects of flat fares would only be slightly reduced (Cervero, 1981). For two of the systems studied, time-of-day fares seemed to retain many of the regressive features of flat fares. The only perceptible equity improvements projected under time-of-day pricing involved an equalization of farebox recovery rates among work and non-work trips. It should be noted that these findings were only conjectural. The analysis presented in Chapter Six of this

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* Farebox recovery rate equals passenger fares divided by operating expenses. A cost recovery ratio equals total revenues (e.g., passenger fares, rental income, etc.) divided by operating expenses.

report attempts to provide more empirical insights into the equity implications of time-of-day pricing.

2.4.4 Institutional Reactions

The decision to implement time-of-day fares is ultimately a political rather than an economic one. There has been little work done on evaluating the attitudes of various political and interest groups towards time-of-day pricing per se. Dillon (1970) addressed the geopolitical context of fare differentials. He notes that suburban interests generally wield greater political clout at the metropolitan level, thus programs to drastically raise the fares of peak hour commuters are likely to face stiff opposition. From transit management's perspective, there's perhaps evidence of stronger support for time-of-day pricing. One survey of 24 transit managers found 18 of the respondents in favor of time-of-day fare differentials (Billingsley and Cureman, 1980). A more recent survey of 99 U.S. transit managers found that over three-quarters were planning major fare hikes in response to proposed federal cuts, with many anticipating structural changes in pricing (Cervero, 1983). Additional insights into the attitudes of users, transit workers, managers, and board officials towards time-of-day pricing are mapped in Chapters Seven and Eight of this report.

Chapter Three

Time-of-Day Transit Fare Programs in the United States

3.1 Introduction

This chapter describes urban transit time-of-day fare programs which have been implemented in the United States. The chronology, characteristics, and rationales of both existing and discontinued programs are presented. Overall, time-of-day pricing has been introduced in a variety of settings for a host of different reasons. Indeed, the contextual setting of each program is unique in its own way.

3.2 Time-of-Day Transit Pricing: Chronology and Settings

3.2.1 Chronology

Table 3.1 chronicles the evolution of time-of-day transit fares programs in the U.S. since 1970.* Thirty-three programs have been introduced between 1970 and 1983, including a one-month experiment with midday discounts on San Francisco's BART rapid rail system. Twelve of these programs were subsequently discontinued (again counting BART's experiment). And in two cases where time-of-day pricing was abandoned, Akron and Youngstown, the differential was eventually reinstated. Thus, as of late 1983, there were twenty-three areas throughout the country which differentiated adult weekday transit fares between peak and off-peak periods. In that transit operations in Spartanburg and Anderson, South Carolina are both managed and controlled by the same public utility, the Duke Power Company, there are actually twenty-two different operators employing time-of-day pricing. (Throughout the remainder of this report, analyses of current systems are conducted on twenty-two cases, combining the Spartanburg and Anderson operations.)

The cumulative total column in Table 3.1 reveals that, except for a small drop-off in 1980, the annual count of properties with time-of-day fares has increased steadily since 1970. By 1977, there were eight cases of time-of-day transit pricing, with only Boston having abandoned its differential on rail services. It's noteworthy that all of the pre-1977 programs involved off-peak discounts. It is probably no coincidence that the growth in fare discounts paralleled the period when operating subsidies from all levels of government were increasing by leaps and bounds. Some of these early time-of-day discounts might have also been induced by the initiation of concessionary fares for elderly patrons. As noted in Chapter Two, Section 16(b)2 of the amended 1964 Urban Mass Transportation Act, which was promulgated in 1974, required that off-peak fares for the elderly be no more than one-half the base rate as a precondition to the receipt of federal operating subsidies. Some of the early adult off-peak discount programs were probably influenced by Section 16(b)2.

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* Only urban or mixed urban/inter-city transit operations whereby weekday fares are differentiated by time-of-day are presented. Free off-peak fare demonstrations, such as the 1978 experiments in Trenton and Denver, are also excluded.

Table 3.1

Chronological Listing: Systems with Time-of-Day Pricing

Year	Property	Number Implemented	Property	Number Discontinued	Cumulative Total
1977 or Before	Erie (1970) Allentown (1972) Boston (1973) (rail) Denver (1973) Louisville (1974) Akron (1974) Rochester (1975) Baltimore (1976) Washington, D.C. (bus) (1975) (rail) (1976)	9	Boston (1975) (rail)	1	8
1978	Burlington Cincinnati Spartanburg/Anderson Walnut Creek	4		0	12
1979	Youngstown	1		0	13
1980	Albuquerque Duluth	2	Akron Baltimore Youngstown	3	12
1981	Chico Columbus Kansas City Orange County Palm Springs Sacramento Salt Lake City St. Louis	8	Albuquerque	1	19
1982*	Akron (reinstated) Chapel Hill Binghamton Kansas City Minneapolis Seattle Tacoma Wilmington Youngstown (reinstated)	8	Duluth Kansas City Palm Springs Rochester St. Louis Walnut Creek	6	21
1983	Wichita	1		0	22

* A one-month experiment with time-of-day pricing by San Francisco's BART rail system during the month of February, 1982 is not included in the Chronology.

The rate of growth in time-of-day transit pricing slowed by the late seventies. In 1981 and 1982, however, there was a second surge. Of the 17 initiated over these two years, 14 involved either peak-only surcharges or differential increases (whereby peak fares rose more than off-peak ones). Moreover, of the seven programs discontinued in 1981 and 1982, five involved midday discounts. Clearly, the trend has been more towards time-of-day differentials which add on charges (either to just the peak or both the peak and base) rather those which deduct them. This reorientation suggests that threats made during the early eighties to eliminate operating subsidies, particularly at the federal level, may have prodded some systems to initiate time-of-day fares as a revenue-generating move. As of late 1983, only Wichita had joined the ranks of systems with time-of-day fares. Whether this is suggestive of a down-turn in recent trends can only be speculated at this point in time.*

3.2.2 Description of Settings

Systems which have introduced time-of-day pricing over the past thirteen years differ in size, service characteristics, governance, and approaches to funding. Metropolitan characteristics also vary. Time-of-day transit fares have been initiated in areas with populations over 3 million as well as in communities under 30,000. The 33 post-1970 programs are distributed in terms of 1980 service area population as follows:

> 1 million	(12) -- San Francisco/Oakland; Washington, D.C.; Boston; St. Louis; Baltimore; Minneapolis/St. Paul; Orange County; Kansas City; Denver; Seattle; Cincinnati; and Columbus.
500,000-1 million	(7) -- Rochester; Salt Lake City; Louisville; Sacramento; Akron; Allentown; and Wilmington.
100,000-500,000	(7) -- Albuquerque; Tacoma; Wichita; Youngstown; Binghamton; Erie; and Duluth.
< 100,000	(7) -- Palms Springs, Ca.; Spartanburg, S.C.; Burlington, Vt.; Chapel Hill, N.C.; Chico, Ca.; Anderson, S.C.; Walnut Creek, Ca.

Thus, time-of-day differentials have been used in all sizes of cities, including a fair number of large ones. Geographically, they have been

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* Other chronologies of specifically peak period surcharges have also been reported. From a survey of 200 transit systems, APTA (1984) reports the following percentages of systems with peak period surcharges: 1977 - 3.7%; 1978 - 4.6%; 1979 - 5.4%; 1980 - 5.1%; 1981 - 4.2%; and 1982 - 9.0%. These rates of change match those presented in Table 3.1, although the table includes all forms of time-of-day pricing. Pickrell (1983) also chronicles changes in the incidence of peak surcharges between 1974 and 1981 for 26 of the nation's largest metropolitan areas. Pickrell notes there were 8 bus and/or rail operations with higher peak hour fares (among the 26 areas) in 1974, compared to only 3 in 1981.

introduced in 19 states plus the nation's capital, with the most cases in California (6), Ohio (4), Maryland (2), Minnesota (2), Missouri (2), New York (2), Pennsylvania (2), South Carolina (2), and Washington State (2).

In terms of service characteristics, time-of-day pricing has been employed on rail (3 - San Francisco, Washington, D.C., and Boston), bus (31), and even dial-a-ride (1 - Orange County) modes of public transportation. For bus systems, variations in fleet sizes, number of routes, and route mileage generally reflect differences in service area populations. Systems with nearly 3,000 active vehicles (Washington Metrobus) and as few as five (Chico) have differentiated fares by peak and off-peak periods.

One statistic particularly relevant to this research is the ratio of peak to base vehicles among systems which have priced transit services by time-of-day. A high ratio would generally be associated with large cost differences between peak and off-peak periods; thus, one would expect systems with high ratios to be likely candidates for time-of-day differentials. The mean peak-to-base ratio of 23 of the 30 non-rail systems which have used time-of-day pricing, and for which data were available, was 2.17 (standard deviation = 0.72).* On average, then, over twice as many vehicles were being deployed during peak as off-peak periods when time-of-day fares were introduced. This figure is higher than the national average peak-to-base ratio of 2.04 during the late seventies (when most of the differentials were initiated) (Oram, 1979). It should be noted, however, that the average derived is based on small and large systems combined. When the total number of peak buses of the 23 systems is summed and divided by the total number of off-peak buses, producing a weighted average, the mean ratio is 2.40. The higher figure indicates that peaking is far more pronounced in the case of larger systems. Compared to the average U.S. property, then, systems which introduced time-of-day fares generally seemed to be good candidates in terms of the degree of peaking.

Among the 22 areas which still price by time-of-day, 12 have predominantly radially-oriented services (i.e., more than 80% of all routes). Five -- Chapel Hill, Columbus, Minneapolis, Sacramento, and Seattle -- could be characterized as having mixed radial/grid/cross-town services, whereas three operate principally along grid networks -- Denver, Orange County, Salt Lake City. Seven of the systems operate special curb-to-curb dial-a-ride van and small bus services in addition to regular fixed-route services, though, again, Orange County is the only area which prices demand-responsive services by time-of-day.

Annual ridership figures among systems still pricing by time-of-day

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* Computations were based on the ratio of peak to base buses for the year in which the time-of-day differential was first introduced in each area. Data were not available for Binghamton, Burlington, Chapel Hill, Spartanburg, Anderson, Palm Springs, and Walnut Creek, all smaller systems whose omissions should not alter the statistics very much. Rail figures for Boson, San Francisco, and Washington, D.C. were also excluded.

range from around 180 million in the case of Washington's Metrobus and Metrorail system to below one million in Chico, Spartanburg, and Anderson. Among the 22 current systems, the average number of (1980) annual revenue passengers was 26 million, with a standard deviation of 41 million. Thus, the distribution is quite dispersed, skewed towards large systems.

Thirteen of the 22 systems have appointed boards (with an average size of 10 members), while four (Chapel Hill, Denver, Salt Lake City, and Tacoma) are governed by elected officials. General-purpose elected officials (i.e., city councilmen and county commissioners) oversee operations in Binghamton, Chico, and Orange County. And in Spartanburg and Anderson, services are run by a public utility company, while Wilmington's bus operation is a subsidiary of the state-run Delaware Transportation Authority.

Finally, systems which currently price services by time-of-day have fairly comparable funding programs. The average farebox recovery rate (i.e., passenger revenues/operating expenses) is 35%, with a standard deviation of 7%.* The distribution is negatively skewed, however with five systems recovering less than 25% of their operating costs through the farebox. Thus, as with most U.S. transit properties, the vast majority of systems with time-of-day differentials are highly dependent upon government subsidies. Of the 22, dedicated tax revenues are also relied upon quite heavily. Sales taxes are earmarked for transit in Chico, Columbus, Denver, Orange County, Sacramento, Salt Lake City, Seattle, and Tacoma. Dedicated property taxes exist in Akron, Washington, D.C., and Youngstown, while earnings taxes support transit in Cincinnati and Louisville. In addition, earmarked state lottery receipts go to help finance Erie's and Allentown's bus operations.**

3.3 Description of Time-of-Day Fare Programs

3.3.1 Characteristics of the Basic Fare Structures

The absolute size as well as the type of time-of-day fare differential for all programs existing between 1980 and 1983 are shown in Table 3.2. Of the 31 programs over this period, fares were originally differentiated via surcharges in 11 areas, discounts in 10 areas, differential increases in 8 areas, and off-peak passes in two areas.*** All

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* Spartanburg/Anderson was omitted in computing average farebox recovery rates since Duke Power Company combines revenue and expense data with those of other utility holdings.

** In addition, gasoline taxes are dedicated by the State of Maryland to help support Washington Metrobus and planned Metrorail services in Montgomery and Prince Georges Counties.

*** Type of fare change is for the original introduction of time-of-day pricing, with the exception of Akron, where the reinstated 1981 differential program is presented. Spartanburg and Anderson are combined as one case of off-peak passes in that both programs were introduced simultaneously by Duke Power Company. Boston's midday discounting of its rail fares, which was discontinued in 1975, is omitted from the table. Historically speaking,

Table 3.2

U.S. Time-of-Day Fare Programs Existing from 1980-1983
by Size of Differential and Type of Fare Change

Transit Property:	Size of Differential Between Peak and Non-Peak Periods:	Type of Fare Change:[1,2]
Columbus	$.35	Midday Discount
Denver[3]	"	Differential Increase
Palm Springs[4,5]	"	Midday Discount
Chico	$.25	Peak Surcharge
Louisville	"	Off-Peak Discount
Tacoma	"	Peak Surcharge
Walnut Creek[4]	"	Peak Surcharge
Albuquerque[4]	$.20	Midday Discount
Rochester[4]	"	Midday Discount
Minneapolis	$.15	Peak Surcharge
Orange County	"	Differential Increase
Wichita	"	Differential Increase
Youngstown	"	Midday Discount
Akron	$.10	Non-Midday Surcharge
Allentown	"	Off-Peak Discount
Binghamton, N.Y.	"	Peak Surcharge
Burlington, Vt.	"	Midday Discount
Cincinnati	"	Differential Increase
Chapel Hill, N.C.	"	Peak Surcharge
Erie	"	Midday Discount
Kansas City[4]	"	Peak Surcharge
Sacramento	"	Peak Surcharge
St. Louis[4]	"	Peak Surcharge
Salt Lake City	"	Differential Increase
Seattle[6]	"	Peak Surcharge
Wilmington[7]	"	Differential Increase
Baltimore[4]	$.05	Differential Increase
Washington[8]	"	Differential Increase
Spartanburg/Anderson, S.C.	--	Off-Peak Pass
Duluth[4]	--	Peak-Restricted Pass

1 Refers to version of time-of-day pricing existing or first introduced between 1980-83. Types of Fare Change are: Differential Increase -- raising the peak fare higher than the off-peak; Midday Discount -- lowering fares only during midday hours; Non-Midday Surcharge -- increasing fares only during non-midday hours; Peak Surcharge -- increasing fares only during peak hours: Off-Peak Discount -- lowering fares for all non-peak hours; whether morning, midday, or evening; Off-Peak Pass -- discounted pass only for use during off-peak periods; Peak-Restricted Pass -- discounted pass restricted during narrow peak time span.

2 San Francisco's BART experiment with time-of-day pricing in February, 1982 is not included. The differential amounted to a 20% discount below the regular fare during the midday period, with the exact amount varying by distance travelled.

3 Denver's local differential is $.35 ($.70 vs. $.35) in the city proper and $.15 ($.50 vs. $.35) in the city of Boulder.

4 Subsequently discontinued time-of-day pricing.

5 For inter-city routes, the differential was $.50 in Palm Springs.

6 Seattle's time-of-day fare differential widens to $.15 for trips between two zones.

7 Wilmington's time-of-day fare differential is only $.10 for travel within any one zone, but is as large as $.85 for travel between four zones.

8 Washington's Metrobus time-of-day fare differential is only $.05 within the District, but is as large as $1.30 for interjurisdictional trips between outer zones in Maryland and Virginia.

surcharges involved add-on peak period fares, except in the case of Akron where the additional charges were for all periods except the midday (i.e., a non-midday surcharge). In that differential fare increases involved raising both peak and off-peak fares, there were actually 19 cases where peak fares were increased (i.e., 11 peak surcharges plus 8 differential increases). Of the 10 discount programs, six were limited to midday periods. Spartanburg/Anderson's discounted pass programs were (and still are) restricted to off-peak hours as was Duluth's, until discontinued in 1982. In general, off-peak and midday-only discount programs have tended to be in medium-sized cities with moderate peak-to-base ratios of demand. Peak surcharges have generally been introduced in smaller cities plus a few larger ones, while differential increases have occurred in mostly mid-to-large size areas. It is noteworthy that there have been no cases of simultaneous peak surcharges and midday discounts, ostensibly because the change in peak users' fares relative to off-peak ones would be glaring.

In absolute terms, the difference between peak and non-peak adult cash fares have been as small as a nickel (in Baltimore and Washington) and as large as 35 cents (in Columbus, Denver, and Palms Springs). In the case of Palms Springs, the differential between the midday and all other hours was actually 50 cents on inter-city runs, until the entire program was ended in 1982. Moreover, in some areas which have both zonal and time-of-day differentials, fares between peak and off-peak periods currently vary by as much as $.85, in the case of Wilmington, and $1.30, in the case of Washington's Metrobus. Overall, 12 of the 32 systems which have introduced time-of-day fares have also employed distance pricing. Baltimore, Cincinnati, Kansas City, Louisville, Minneapolis, Orange County, Sacramento, Salt Lake City, Seattle, Washington, and Wilmington all have zonal fares, while San Francisco's BART uses graduated pricing.* The time-of-day differential widens over inter-zonal trips only in Seattle, Washington, and Wilmington. (It also widened with distance during BART's one month experiment). Washington Metrorail's version of combined time-of-day/distance pricing is particularly unique in that distance surcharges are only added onto the 75 cents boarding fare during peak hours.

In relative terms, Table 3.3 shows that Columbus currently has the largest differential -- base period fares are 140% higher than midday ones. The average differential among the 21 current (adult cash) programs is 40%, and the most frequently occurring differential is 25% (7 cases). There are no obvious patterns between sizes and types of differentials. The highest peak fare (adult cash, one zone) is Chico's 85 cents while the lowest off-peak fare is Columbus's 25 cents. Among discontinued programs, Boston's 150% "dime time" midday reduction was the largest.

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then, there have been equal numbers of discount and surcharge time-of-day fare programs -- 11 of each.

* Orange County's combined time-of-day and distance pricing program is limited to dial-a-ride services (which operate between 12 different zones). Only Kansas City simultaneously introduced both time-of-day and zonal fares.

Table 3.3

Relative Size of Time-of-Day
Fare Differential

Transit Property:	Basic Adult Peak Fare[1]:	Basic Adult Off-Peak Fare[2]:	% of Fare Above Off-Peak Fare:
Existing Programs[3]			
Columbus	60	25	140.0
Denver	70	35	100.0
Tacoma	50	25	"
Louisville	60	35	71.4
Burlington	75	50	50.0
Chico	85	60	41.7
Youngstown	60	45	33.3
Minneapolis	75	60	25.0
Orange County	"	"	"
Wichita	"	"	"
Allentown	50	40	"
Binghamton	"	"	"
Chapel Hill	"	"	"
Salt Lake City	"	"	"
Akron	60	50	20.0
Cincinnati	"	"	"
Erie	"	"	"
Sacramento	"	"	"
Seattle	"	"	"
Wilmington	70	60	16.7
Washington	75	70	7.1
Discontinued Programs[4]			
Boston[5]	25	10	150.0
Palm Springs	60	25	140.0
Walnut Creek	50	25	100.0
Albuquerque	40	20	"
Kansas City	60	50	"
San Francisco[5]	"	"	"
St. Louis	"	"	"
Baltimore	40	35	14.3

1 Represents the base period for discount programs.

2 Represents the base period for surcharge programs.

3 Adult cash fare for, where applicable, one zone of travel, as of September 1983. Spartanburg/Anderson are omitted since fares are differentiated soley by passes.

4 Last differential before time-of-day pricing was discontinued. See Table 3.1 for date of abolition. Duluth's off-peak pass experiment is omitted.

5 For rail services. In the case of BART, the differential is for trips up to 6 miles in length.

For almost all systems, the time-of-day differential which was initially set has eroded in real dollar terms because of inflation. Only Denver, Burlington, and Cincinnati have widened their time-of-day differential since its inception -- Denver, from 10 cents to 35 cents, Burlington from 10 cents to 15 cents, and Cincinnati, from a nickel to a dime. Several others, notably Akron, Washington, and Youngstown, have decreased their time-of-day differential in both absolute and relative terms. Washington, in particular, has witnessed more variations in time-of-day pricing than any other region of the country, with over ten renditions since 1975. (See Appendix I.19 for a discussion of Washington's fare history.)

Of further note is the differentiation of transfer fees by time-of-day in Chapel Hill and Washington, D.C. Transfers from Chapel Hill's campus shuttle bus to arterial routes cost 25 cents during the peak and only 20 cents during the off-peak. Transfers from bus to rail, or vice-versa, on Washington's Metro system are discounted up to 80 cents, depending on distance, during the off-peak.

3.3.2 Pre-Payment Provisions

Most systems rely on cash payment to collect peak/off-peak differentials.* However, several rely solely on passes, while others use combinations of cash, passes, and ticket prepayment. Table 3.4 describes seven discount pass programs limited to off-peak periods, five of which currently exist. This is perhaps a surprising number of cases since pre-paid discount passes are normally designed for regular rush hour customers. Discounts ranged from 12% to 100%. Also, passes in four of the larger cities require surcharges ranging from a quarter to $1.55. Four multi-ride ticket programs also exist among the 22 current cases, offering discounts as high as 100% to users who travel during off-peak hours. Also, lower priced tokens, good only for off-peak periods, are available in Burlington and Erie. Another noteworthy example of where pre-paid tokens are being used to facilitate the time-of-day differential is in Denver. There, the 35 cents off-peak fare, 70 cents peak fare, $1.05 express fare, and $1.75 regional fare were all set to multiples of the 35 cents token. Management sought to encourage token usage in order to get payments off of the bus, thus resulting in a one token off-peak fare, a two token peak fare, a three token express fare, and a five token regional fare.

3.3.3 Time-of-Day Pricing and Special Services

Few instances of time-of-day pricing on special services were found among systems studied. Nine systems operate downtown shuttle services which are either free or cost a dime, or in the case of Columbus, 60 cents during peak periods. Columbus is the only system which charges more for shuttle services during the peak. (Services are free during the midday). As mentioned previously, Orange County is the only area

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* Among systems which currently vary fares by time-of-day, the differential is collected solely through cash payment in Akron, Allentown, Chapel Hill, Cincinnati, Louisville, Minneapolis, Sacramento, Salt Lake City, Tacoma, and Youngstown.

Table 3.4

Time-of-Day Prepayment Provisions

Discount Pass Programs	Descriptions
Baltimore	Off-peak only pass discounted at 12%. Off-peak pass has been retained even though the cash differential was discontinued.
Binghamton	A discounted monthly pass which can be used by any family member (up to five at one time) during off-peak periods only.
Columbus	Pass discounted at 100% limited to midday period -- 9:30 a.m. to 3:00 p.m.
Duluth	Off-peak unlimited use pass discounted at 27% below regular pass. Restricted during hours of 7:30-8:00 a.m. to promote flex-time program. Demonstration program was discontinued in August, 1982.
Palm Springs	A 20% discounted off-peak pass that was discontinued in September, 1982.
Seattle	Off-peak pass discounted at 20% below peak period pass. Can be purchased for monthly or annual usage, over one or two zones. Annual, two zone off-pass, for example, costs $66 less than comparable peak-period pass.
Spartanburg/Anderson	30-day discounted unlimited ride pass, good only for off-peak hours.

Pass Surcharge Programs	Descriptions
Denver	A 25-cent surcharge is required during peak periods on all monthly passes for circulator (neighborhood) services.
Minneapolis	Passes for different combinations of zones contain peak period surcharge.
Orange County	A 40-cent surcharge is required during peak periods in all senior citizens passes.
Washington, D.C.	Depending upon zones crossed, distance surcharges up to $1.55 are added onto unlimited-ride passes during peak hours. No surcharges are collected during the off-peak.

Multi-Ride Tickets/ Punch Card Programs	Descriptions
Burlington	10-ride ticket discounted at 100% if used during off-peak only.
Columbus	50-cent unlimited ride ticket good only for midday period.
Spartanburg/Anderson	16-ride ticket discounted at 37.5% and good only during off-peak hours.
Wilmington	20-ride ticket discounted 17% if used only during midday hours. Amounts to a savings of 5 cents per trip.

Token Programs	Descriptions
Burlington	35-cent tokens can be used during off-peak hours, a savings of 43% from off-peak cash fare and 114% from peak cash fare.
Erie	An 11% discounted student token can also be used by adults during off-peak hours.

which currently charges more for peak hour services on its dial-a-ride operation -- $1.25 during the off-peak and $1.50 during the peak, with additional with additional surcharges between zones.

3.3.4 Time-of-Day Concessionary Fares

Every system which currently prices adult fares by time-of-day also provides special discounts for certain groups considered deserving of assistance, typically senior citizens, handicapped passengers, children, and students. Some extend the off-peak discounts granted to adult passengers to all hours of the day for these groups. Others offer even lower off-peak discounts to elderly and disabled patrons than those provided to regular adult customers. And still others provide a separate time-of-day differential for elderly, handicapped, and, in some cases, students -- i.e., concessionary fares are varied between peak and off-peak hours, although at different rates than those for regular passengers.

The interested reader is directed to Appendix I for details about the time-of-day features of concessionary fares for properties which have also introduced peak/off-peak differentials for adult customers. In addition, Table 3.5 summarizes information on concessionary time-of-day fares for the 22 current programs. Regarding special fares for elderly and handicapped passengers, the discounts are also differentiated by time-of-day in Allentown, Binghamton, Burlington, Chapel Hill, Denver, Erie, Minneapolis, Orange County, Salt Lake City, and Tacoma. In most of these cases, concessionary fares were differentiated by 100% or more. For student and pre-school passengers, discounts vary by peak and off-peak periods in six areas.

In support of legislative mandates, 18 of the 22 systems offer elderly and handicapped off-peak fares which are more than 100% below peak adult fares. Spartanburg/Anderson and Chico, areas which receive no federal assistance, have chosen instead to provide senior citizens discounts only through pre-paid passes. In 14 of the 22 areas, off-peak elderly and handicapped fares are still 100% or more below off-peak adult fares. And in 16 areas, peak fares for the elderly and handicapped are 100% or more below those for adult passengers.

Table 3.5 also shows that over two-thirds of the 22 system vary student/youth cash fares during both peak and off-peak hours below those offerred to adults. In Chapel Hill, Minneapolis, Sacramento, and Tacoma, student/youth cash discounts themselves are varied by time-of-day. Discounts for school-age passengers are limited to passes, however, in the cases of Denver, Orange County, Salt Lake City, Seattle, Tacoma, Washington, and Wilmington.

3.3.5 Designated Peak/Off-Peak Time Periods

Table 3.6 presents the designated hours of the peak and off-peak periods for systems which have implemented time-of-day pricing. The table divides programs into those where peak hours have been designated (usually peak-surcharges and differential increases) and those where special off-peak hours have been defined (usually discount programs). For programs with designated peak hours, the duration of the combined morning and evening peaks have ranged from one-half hour in the case of

Table 3.5

Concessionary Cash Fares Among 22 Systems
Currently Pricing By Time-of-Day

	Free Fare[1]	>100	100	50-99	1-49	0
		Differential (%)				
No. of Programs Where:						
Elderly and handicapped off-peak fares are below elderly and handicapped peak fares by following differential[2]	0	4	1	2	0	13
Elderly-only off-peak fares are below elderly-only peak fares by following differential[2]	3	0	0	0	0	0
Handicapped-only off-peak fares are below handicapped-only peak fares by following differential[2]	0	2	1	0	0	0
Student/youth off-peak fares are below student/youth peak fares by following differential[3]	0	1	1	0	4	16
No. of Programs Where Elderly and Handicapped Off-Peak Fares are:						
Below adult peak fares by following differential	3	15	2	0	0	2[4]
Below adult off-peak fares by following differential	2	7	5	5	1	2
No. of Programs Where Elderly and Handicapped Peak Fares are Below Adult Peak Fares by Following Differential:	0	11	5	0	0	6
No. of Programs Where Student/Youth Off-Peak Fares are:						
Below adult peak fares by following differential[5]	0	4	3	4	4	7
Below adult off-peak fares by following differential[5]	0	1	2	4	7	11
No. of Programs Where Student/Youth Peak Fares are Below Adult Peak Fares by Following Differential:[5]	0	5	2	6	2	7

1 The subject fare is free, thus the differential is actually infinity.

2 Allentown, Erie, and Orange County have distinctly different elderly discount programs than handicapped discount programs. Thus, separate accounts are made for elderly-only and handicapped-only programs in these three cases. In most cases where there is no differential, the off-peak fare is good for all hours of the day.

3 Cases of no differential either are cities which offer no cash concessionary fares or which the off-peak fare is good for all hours of the day.

4 Since no federal operating assistance is received in Chico and Spartanburg/Anderson, the one-half elderly fare requirement does not apply in these two cases.

5 Denver, Orange County, Salt Lake City, Seattle, Tacoma, Washington, and Wilmington do not offer student/youth cash fare concession, although special discounted student/youth passes are offered.

Table 3.6

Comparison of Time Period Intervals
Amongst Transit Properties With Time-of-Day Fares Since 1970[1]

Properties with Designated Peak Hours

Properties:	Designated Peak:	Duration (no. of hrs.)
Washington, D.C.	6:00-9:30 a.m. 3:00-6:30 p.m.	7.0
Baltimore*	6:00-9:00 a.m. 3:00-6:00 p.m.	6.0
Cincinnati	"	"
Denver	"	"
Kansas City*	"	"
Orange County	"	"
St. Louis*	"	"
Seattle	"	"
Minneapolis	6:00-9:00 a.m. 3:30-6:30 p.m.	"
Binghamton	6:15-9:15 a.m. 3:15-6:15 p.m.	"
Chapel Hill	6:30-9:30 a.m. 3:00-6:00 p.m.	"
Tacoma	5:00-9:00 a.m. 4:00-6:00 p.m.	"
Seattle[2]	6:00-8:45 a.m. 3:15-6:00 p.m.	5.5
Sacramento	6:30-9:00 a.m. 3:30-6:00 p.m.	5.0
Louisville	6:30-8:30 a.m. 3:30-5:30 p.m.	4.0
Salt Lake City[3]	"	"
Duluth*	7:30-8:00 a.m.	0.5

Properties with Designated Off-Peak Hours

Properties:	Designated Off-Peak:	Duration (no. of hrs.)
Albuquerque	9:00 a.m.-3:00 p.m.	6.0
Spartanburg/Anderson	"	"
Wilmington	"	"
Burlington	9:15 a.m.-3:15 p.m.	"
Wichita	9:45 a.m.-3:45 p.m.	"
Columbus	9:30 a.m.-3:00 p.m.	5.5
Youngstown	9:30 a.m.-2:30 p.m.	5.0
Allentown	10:00 a.m.-3:00 p.m.	"
San Francisco (rail)*	"	"
Rochester*	10:00 a.m.-2:30 p.m.	4.5
Akron	10:00 a.m.-2:00 p.m.	4.0
Erie	"	"
Palm Springs*	"	"
Boston (rail)*	10:00 a.m.-1:00 p.m.	3.0

* Discontinued time-of-day differential

1 For latest version of time-of-day pricing for those propeties which revised designated hours

2 Seattle's actual hour intervals are 6-9 a.m. and 3:30-6 p.m. for inbound trips and 6-8:30 a.m. and 3-6 p.m. for outbound trips. Hours shown are on average of this range.

3 Designated Peak Hour is actually from the first bus in the morning to 8:30 a.m., which is for most runs from 6:30-8:30 a.m..

Duluth's two-year experiment to Washington's current seven hour peak. Washington's peak encompasses the earliest and latest a.m. times (6:00 and 9:30) as well as the earliest and latest p.m. times (3:00 and 6:30). The most common time length designated for the peak has been six hours, while the average among the sixteen properties shown in Table 3.6 is 5 hours and 43 minutes.* Eleven properties have used the six hour peak definition, although there have been five different versions of it, the most common being 6-9 a.m. and 3-6 p.m.

The duration of the peak period can be a critical factor regarding whether or not ridership shifts between time periods occur. Too wide of a time band can effectively preclude any shifting to the off-peak. On the other hand, too narrow of a band might result in an excessive loss of passenger revenues. Indeed, some of the most vocal user protests against time-of-day fare programs to date have been over the duration of the designated peak, with some passengers charging that properties are only interested in collecting more money from commuters rather than encouraging shifts (see Denver and Washington case studies, in Appendices I.9 and I.19, for example.). In that most shifts could be expected from the shoulders, rather than the heart, of the peak, transit managers counter that the cost savings of this redistribution in demand would be minimal, while the revenue losses could be severe. Moreover, wide hours can reduce the incidence of fare disputes since fewer numbers of passengers would be boarding at time-breaks. Indeed, the original designated peak period was extended by one hour in the case of Orange County and two hours in the cases of Denver and Washington for these very reasons.

From Table 3.6, it appears that the largest transit properties have the longest designated peak periods, most likely because the peak load extends over more hours. It's probably also the case that larger systems stand to lose the most money from narrow peak time bands. Overall, one would expect the incidence of shifting to be the highest in places like Louisville and Salt Lake City which have relatively narrow designated peaks and the exact opposite in places like Washington, Cincinnati, and Denver. The ridership and revenue implications of designated peak hours are addressed further in Chapters Four and Five.

Regarding the designated off-peak hours, the most frequent and longest time length has been 6 hours, while the shortest has been 3 hours. Midday periods have commenced as early as 9:00 a.m. and have been extended as late as 3:45 p.m. A comparable ridership-revenue trade-off is involved in defining midday periods. Generally, narrow bands concentrated on the noon hour aim to attract lunchtime traffic. Longer durations, particularly those which extend beyond 3:00 p.m., often are designed to serve early afternoon shoppers as well as provide a discount to students returning home from school. Overall, one might expect places such as Wilmington, Burlington, and Wichita to experience relatively high rates of ridership shifting since their midday periods encompass relatively long time spans.

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* Duluth's one-half hour designated morning peak is not included in the average duration computation since it's unrepresentative.

Some systems have also extended off-peak discounts to weekends as well. (In all cases, peak period surcharges are collected only during weekdays.) Notably, discounts are extended to Saturdays in Allentown, Spartanburg/Anderson, and Wilmington. And in Binghamton, Erie, Louisville, Palm Springs, Salt Lake City, and Washington, they have been extended to both Saturdays and Sundays.*

3.4 Rationales for Adopting Time-of-Day Pricing

Interviews were conducted with transit managers, board members, and other officials from areas which have implemented time-of-day fares since 1970. A wealth of background information was collected from these interviews, including insights into why time-of-day pricing was originally introduced. Although each interviewee had his or her own perspective on this, in general responses were quite consistent. Where there were differences of opinion, the most frequently cited rationales, as well as those identified by persons who were most intimately involved in the creation of the fare differential, were recorded. A more detailed discussion of the reasons behind each of the time-of-day fare programs can be found in each case summary in Appendix I of Volume 2.

Table 3.7 presents six major reasons cited by interviewees for initiating time-of-day pricing, along with several others unique to individual areas. Both primary and secondary reasons were identified. The most frequently cited reason was to increase midday and off-peak ridership, identified by 21 of 31 systems. For twelve systems this was the primary rationale, couched in terms of increasing off-peak patronage so as to make more efficient use of available seating capacity. The prospect of raising more revenues was the major motivation for nine of the systems, and a secondary reason for Cincinnati and Orange County. Moreover, eleven of the systems opted for time-of-day pricing on equity grounds, though this was often a more secondary objective. Other multiple reasons (i.e., cited by more than one property) were to recover higher shares of peak period costs, to minimize overall ridership losses, and to strengthen downtown commercial activities.

A number of fairly unique reasons were also recorded. Louisville instituted time-of-day pricing primarily because it had been institutionalized in the area by the inherited private bus company (see Appendix I.11).** Minneapolis, on the other, was almost forced to institute a peak surcharge since the Minnesota Legislature precluded the raising of base period fares as a quid pro quo for state operating assistance (see Appendix I.12). And in Seattle, a secondary reason cited was that time-of-day fares would result in an equitable distribution of subsidy responsibilities among regional jurisdictions since outlying commuters would be paying higher fares (see Appendix I.16).

One would generally expect the specific type of time-of-day fare program introduced by properties to reflect these underlying rationales.

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* Erie's midday discount is extended to all hours on Sunday.

** The original reason for Louisville Transit Company's initiation of time-of-day pricing in the early sixties could not be ascertained.

Table 3.7

Reasons for Implementing Time-of-Day Pricing

Reasons:	Systems Citing Reasons (Primary or Secondary):
(1) Increase Midday Ridership -- (encourage ridership shifts from peak to midday; better utilize off-peak capacity)	Primary Reason (12 systems) -- Akron, Allentown, Albuquerque,* Boston,* Burlington, Cincinnati, Columbus, Denver, Duluth,* Erie, Palm Springs,* Rochester;* Secondary Reason (9 systems) -- Chapel Hill, Binghamton, Louisville, Sacramento, Spartanburg/Anderson, Walnut Creek, Wichita, Wilmington, Washington, D.C.; (21 Systems Total)[1]
(2) Increase Revenues -- (generate higher farebox recovery rate; cover a higher share of peak costs)	Primary Reason (9 systems) -- Binghamton, Chico, Chapel Hill, Minneapolis, St. Louis,* Salt Lake City, Seattle, Walnut Creek, Wichita; Secondary Reason (2 systems) -- Cincinnati, Orange County (11 Systems Total)
(3) Make Fare System More Equitable -- (help low income and transit-dependent users the most through off-peak discounts)	Primary Reason (4 systems) -- Baltimore,* Kansas City,* Spartanburg/Anderson, Tacoma;* Secondary Reason (7 systems) -- Allentown, Cincinnati, Denver, Seattle, Washington, D.C., Wichita, Youngstown (11 Systems Total)
(4) Recover Higher Shares of Peak Period Service Costs	Primary Reason (4 systems) -- Orange County, Sacramento, Washington, D.C., Wilmington; Secondary Reason (4 systems) -- Binghamton, Cincinnati, Tacoma, Walnut Creek (8 systems total)
(5) Minimize Ridership Losses -- (due to lower demand elasticity of peak period)	Primary Reason (None); Secondary Reason -- Baltimore,* Binghamton, Kansas City,* Salt Lake City, Seattle, Washington, D.C. (6 Systems Total)
(6) Strengthen Downtown Core and Stimulate Business Activities	Primary Reason (1 system) -- Youngstown; Secondary Reason (2 systems) -- Columbus, Wilmington; (3 Systems Total)
(7) Other Reasons: Inherited policies of private bus system (Louisville) Strengthen downtown core (Columbus, Youngstown) Promote jurisdictional equity (Seattle) State mandated (Minneapolis)	

* Time-of-Day fare differential was subsequently discontinued

1 San Francisco BART's one month experiment with time-of-day pricing in February, 1982 was not included. The experiment sought mainly to increase midday ridership.

Table 3.8 investigates this by cross-tabulating primary and secondary reasons cited by type of time-of-day differential introduced. Not surprisingly, off-peak and midday discount programs were instituted primarily by agencies which sought to increase midday ridership. Four properties which initiated surcharge programs also did so to increase midday ridership, perhaps believing that shifts would result. Those seeking to increase revenues initiated either peak surcharges or differential increases (of both peak and off-peak fares). All types of time-of-day programs were linked to the equity goal. And expectedly, systems which desired to minimize ridership losses instituted either surcharges or differential increases, under the belief that peak users are more price-insensitive. The goal of strengthening the downtown area was the primary force behind Youngstown's midday discount program and the secondary reason for Columbus's. Overall, Table 3.8 shows that increasing ridership was cited nearly twice as frequently as a reason for implementing time-of-day fares as any other.

In reality, all programs are products of a wide array of stimuluses rather than any one factor. In particular, all were politically motivated, though perhaps some were more so than others. In several places, notably Cincinnati and Washington, interviewees intimated that higher peak period fares arose out of efforts to exact higher levels of funding support from suburban residents. (See Chapter Eight for a discussion of these two cases.) Salt Lake City's program was strongly influenced by active student protests against a proposed abolition of a discounted pass, with both student groups and the Utah Transit Authority accepting the creation of an off-pek discount as a compromise (see Appendix I.15.). As mentioned above, Minneapolis's peak surcharge was also more reactionary than initiative, effectively a response to a state mandate. Moreover, Orange County introduced its fare differential, in part, because of a need to attain a farebox recovery rate of at least 20% in order to receive state assistance (see Appendix I.13). Nine other agencies also introduced their programs as part of a larger effort to achieve farebox recovery targets.* And officials in Binghamton, Kansas City, and Salt Lake City volunteered that their programs were initiated directly in response to proposed federal cuts in operating subsidies.

In Akron, Columbus, and Tacoma, discount programs were also designed in order to gain public support for dedicated tax programs (which were approved in all three cases).** Officials in these cities effectively used incentive fares as levers to transfer some of transit's funding responsibilities from users to area taxpayers. In Columbus's

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* Specific recovery targets established were: Baltimore - 50%; Binghamton - 50%; Cincinnati - 45%; Minneapolis - 45%; St. Louis - 30%; Seattle - 30%; Tacoma - 35%; Wichita - 30%; and Wilmington - 45%. Interestingly, St. Louis later discontinued its surcharge program in order to attain a 33% recovery rate, suggesting that differentials are looked upon both positively and negatively in terms of revenue potential.

** Akron's original fare program involved a midday discount rather than a surcharge. Its 1972 one mill property tax passed partly on the promise that fares would be discounted.

Table 3.8

A Cross-Tabulation of Rationales and Type of Time-of-Day Fare Program

	Reasons Cited for Initiating Time-of-Day Pricing													
	Increase Midday Ridership		Increase Revenues		Make Fares More Equitable		Recover Higher Shares of Costs		Minimize Ridership Losses		Strengthen CBD		Others	
Ranking:[1]	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.	Pri.	Sec.
Type of Fare Change:[2]														
Peak or Non-Midday Surcharge	1	4	7	0	2	1	1	2	0	3	0	0	0	2
Off-Peak or Midday Discount	8	1	0	0	0	2	0	0	0	0	1	1	1	0
Differential Increase	2	3	2	2	1	4	3	1	0	3	0	1	0	0
Off-Peak Pass	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Total:	12	9	9	2	4	7	4	3	0	6	1	2	1	2
Total Citing Reason as Preliminary or Secondary	21		11		11		7		6		3		3	

[1] Pri. = Primary Reason; Sec. = Secondary Reason

[2] See Table 3.7 for definitions

case, the discount fare program was part of a larger comprehensive effort to stimulate downtown retail activities. Denver also introduced time-of-day pricing as part of a larger comprehensive program to stimulate the central city, but perhaps more importantly to improve regional air quality (see Appendix I.9). And in Duluth, the off-peak discounted pass program aimed to promote both flex-time work schedules and fare pre-payment.

A number of fare programs were designed around unique equity rationales. Baltimore, for instance, initiated its off-peak pass arrangement partly to offset the shortening of several inner city fare zones which was expected to hurt poor residents the most. Spartanburg and Anderson wanted to avoid granting special fare privileges to any one group of consumers, so they initiated discounts in the form of an off-peak pass, expecting senior citizens to be the primary beneficiaries. Orange County and Cincinnati officials indicated their programs were designed partly to extend required half-fare program for elderly passengers to other needy residents. Discounted senior citizens fares evidently influenced the creation of time-of-day fares for adult customers in several areas.

Other programs were designed partly for promotional purposes. Both Cincinnati and Columbus used off-peak discounts to promote their systems' images as well as to induce people to initially try public transportation in the hopes that they could eventually be won over from their automobiles. Programs in Boston, Duluth, and San Francisco were originally set up to test the ridership effects of discounts. Still other programs had logistical rationales behind them. Walnut Creek, for instance, initiated its surcharge to protect losses from a transfer agreement with BART which often resulted in free evening bus rides; accordingly, peak fares were doubled to partly offset this (see Appendix I.32). St. Louis initiated its surcharge partly because fares had risen rapidly over a relatively short period of time and local officials wanted to restrict the increase to rush hour customers. Both Wilmington and Duluth officials indicated that they initiated their programs, in part, to improve peak hour conditions in the hope that crunch loads would be attenuated.

Several additional insights about the genesis of time-of-day fare programs came out of the interviews. In almost all cases, general managers or senior staff were the originators of the time-of-day pricing idea. Boards generally played a secondary role in formulating the proposals, though their full support was critical in most places. Managers in both Akron and Allentown indicated that they were sold on the idea of midday discounts by Erie's experiences, and were encouraged to initiate their own program's by the city's transit manager. In Wilmington and Baltimore, private management firms were initial advocates of time-of-day pricing. Interestingly, however, private managers were instrumental in the discontinuation of time-of-day fares in St. Louis.

Finally, there were few reasons given for why particular differentials sizes were arrived at. Orange County officials indicated that a relatively small 15 cents differential was adopted because the system's peak-to-base ratio is the smallest in the country among properties of comparable size. Since bus routes in Orange County generally operate on a modified grid rather than a radial pattern, officials believed that

only a modest differential was appropriate. Several other areas indicated that small differentials were initially adopted under the premise that once the public accepted the idea of time-of-day pricing, the variation in peak and off-peak fares could be widened. There were few cases, however, where this actually occurred.

3.5 Reasons and Impacts Associated with Discontinued Time-of-Day Fare Programs

Time-of-day fare programs have been discontinued in twelve areas, though in Akron and Youngstown they were eventually reinstated. Table 3.9 cites the primary reasons given for discontinuation. Akron, Baltimore, Palm Springs, Rochester, St. Louis, and Youngstown abandoned their programs because they felt too much money was being lost. Most had initiated off-peak discounts. Implementation problems were identified as major reasons for eliminating differentials in Albuquerque, Baltimore, Kansas City, and Walnut Creek. Duluth, on the other hand, ended its off-peak pass discount because there was little evidence of ridership shifting.

Programs were particularly short-lived in Albuquerque, Kansas City, Palm Springs, and St. Louis. In Rochester and Walnut Creek, by contrast, time-of-day pricing existed for over seven years. Although Table 3.9 summarizes the overriding reasons for ending time-of-day pricing in these areas, a host of other factors were at play as well. Below, the impacts of the fare programs and reasons for eliminating them are summarized for each of the twelve areas in chronological order of discontinuance.

1. Boston. Boston's "dime-time" fare program, implemented on its rail system in 1973, yielded about a 7% increase in midday ridership, but at a cost of $2.2 million in lost annual revenues. Planners felt that the short designated midday period (originally 10 a.m. to 1 p.m.) failed to entice enough additional riders to the midday. The absence of an areawide staggered work hours arrangement was also cited as a reason few shifts occurred. Another deterrent to the program was a state mandate calling for the simplification of fare policies. Bostonians seemed indifferent to the elimination of dime-time. See Appendix I.25 for further discussion.

2. Akron. Akron's midday discount was discontinued in 1981 in anticipation of cuts in federal operating assistance. Officials felt they could no longer underwrite the cost of midday trips. However, the uniform fare seemed to be causing ridership to decline markedly. Officials reinstated the differential in 1982 when the basic fare was increased to 55 cents while the midday fare was left at 50 cents. See Appendix I.1 for further discussion.

3. Baltimore. Following Baltimore's 1976 differentiation of peak and off-peak fares, both ridership and cost recovery levels declined. The differential helped to stabilized off-peak patronage, however farebox revenues plummetted. Ridership actually declined more quickly after the differential was discontinued, although the system's cost recovery ratio rose. Flat fares were reimplemented as part of an effort to attain a 50% recovery rate. Officials also cited increases in driver-rider confrontations, partly due to the

Table 3.9

Reasons for Discontinuing Time-of-Day Pricing

Reasons	Systems Citing as Primary Reasons	Total Time Reason Cited
(1) Inadequate Revenue Generation	Akron,** Baltimore, Boston, Palm Springs, Rochester, St. Louis, Youngstown**	6
(2) Implementation Problems	Albuquerque (couldn't trace ridership shifts to evaluate fare differential) Baltimore (frequent user-driver confrontations over fare payment) Kansas City (labor and staff resistance: fare too complex), Walnut Creek (desire to keep fares simple)	4
(3) Ridership Failed to Increase	Duluth	1

** Subsequently reinstated time-of-day pricing

strict adherence to time in differentiating fares, as another reason for dropping the program. There was no user backlash to eliminating the differential. Baltimore has continued its 20% discount off-peak pass program, however. See I.24 for further discussion.

4. Youngstown. Youngstown discontinued its midday discount programs in 1980 after downtown business merchants, who had underwritten half the costs of the program, withdrew their support. The program was reestablished following a brief bout with bankruptcy when merchants renewed their support. See Appendix I.22 for further discussion.

5. Albuquerque. Within a year of Albuquerque's adoption of a midday discount, the program was ended. Since fareboxes were not designed to register half-fare payments separately and drivers could not accurately maintain ridership counts, staff could not determine the success of the program. Overall, most local officials felt there were few beneficiaries. Most workers and students could not change their schedules to take advantage of the programs. Elderly patrons did not benefit since they were already paying half-fares during the off-peak. In that there were few program advocates, staff was not surprised when no one showed up at a public hearing held on eliminating the midday discount. See Appendix I.23 for further discussion.

6. Duluth. Duluth's discount pass programs, restricted during the rush period of 7:30-8:00 a.m., was initiated as a demonstration program to promote flex-time and employer-administered prepayment. Overall, system ridership declined 25% during the two years the program was in place, primarily due to other factors. Researchers concluded that no more than 1% of all transit trips during 1981 were generated by the program. The demonstration also failed to reduce the sharp pre-8 o'clock peaks. Only one flex-time program was initiated during the demonstration. Most employers felt the costs of administering the program were not worth the benefits of flex-time. In that pass-users were not a large share of overall ridership, researchers concluded the cost of the program could probably not be sustained. Overall, the reaction to the demonstration was luke-warm and the reaction to its elimination was one of indifference. See Appendix I.26 for further discussion.

7. St. Louis. Ridership had declined steadily following St. Louis's 1981 institution of a 10 cents peak period surcharge. No changes in the distribution of ridership had resulted. As part of a major shake-up in the transit system's management, uniform pricing was reinstituted within one year of peak pricing's adoption. Cost recovery rates rose more with the reinitiation of flat fares than they had during the seven months of time-of-day pricing. Few complaints were aired following the elimination of the differential. See Appendix I.31 for further discussion.

8. Rochester. Rochester generally experienced positive results during its seven years of discounting midday fares. Off-peak ridership had risen steadily over this time, even though peak usage was declining. Staff felt a fair amount of shifting was occurring. The program was eliminated because of the need to generate more

revenues to cover rising deficits. The New York Department of Transportation was critical of Rochester's midday discount and free downtown zone program given the transit system's financial problems. Some also criticized the program for benefitting lunchtime professionals and others capable of paying a full fare. Unlike most other areas, the transit staff was a strong advocate of the program. With pressures to increase revenues and simplify fares, policymakers increased fares across-the-board against a backdrop of staff resistance. See Appendix I.29 for further discussion.

9. Palms Springs. Palm Springs eliminated its 150% midday discount program within a year because too much revenue was being lost and not enough trips were shifting to the off-peak. Staff felt that too many elderly patrons were already receiving low fares to make the program worthwhile. Also, hot noon time weather during much of the year discouraged midday bus usage in general. Most users were indifferent to the program's elimination, although a few formal complaints were lodged by non-elderly lower income persons who saw their fares nearly triple as a result. See Appendix I.28 for further discussion.

10. Walnut Creek. Walnut Creek, east of San Francisco and Oakland, had a 100% peak period surcharge for over seven years. Few impacts of the program were recorded. Some observers felt the program's affect on travel behavior was negligible. The changeover from a municipal agency to a county transit district witnessed a change in service policy as well as an elimination of the fare program. The differential was discontinued primarily to simplify the fare structure. The availability of a broader base of financial support under the new county transit district also spurred this change in pricing policy. See Appendix I.32 for further discussion.

11. San Francisco. San Francisco's BART rapid rail system experimented with a 20% off-peak discount program during the month of February, 1982. Ridership increased only about 2% as a result of the program, while revenues dropped. The short trial period and lack of aggressive program marketing probably detracted from its potential success. There is no indication that the discount will be reinstated. See Appendix I.30 for further discussion.

12. Kansas City. Kansas City simultaneously introduced zonal fares and a time-of-day differential in 1981, abandoning the peak/off-peak component one year later. Due to the complexity of the fare system, the level of user confusion was high. Staff felt the fare system's complexity was becoming a barrier to usage. Driver representatives filed a grievance over it. Officials felt "too much" was done "too quickly" to make fares efficient and equitable, so time-of-day pricing was quickly nixed. No user complaints were aired over the discontinuation. See Appendix I.27 for further discussion.

In sum, most of the time-of-day fare programs which have been eliminated were done so mainly because too much money was being lost and too few additional trips were being attracted. Some instances of implementation difficulties and public resistance were also reported. Several programs were ostensibly discontinued because there were no real

constituents. Notably, elderly customers were already receiving off-peak discounts, so few were reaping the benefits of lower off-peak fares. The inability to encourage ridership shifts also seemed to be a downfall of some. Overall, pressures to reduce operating deficits was the major impetus behind the abandonment of most time-of-day fare programs.

3.6 Summary

The characteristics of areas which have adopted time-of-day transit pricing since the early seventies as well as the features of the differential fare programs themselves have been presented in this chapter. Major rationales for their creation and, in some cases, their discontinuation have also been presented. Overall, a diverse mix of time-of-day fare programs exist. Each has been shaped by an assortment of political, economic, and environmental factors. The next three chapters concentrate on examining the ridership, financial, equity trends and impacts associated with these fare programs.

Chapter Four

Ridership Impacts of Time-of-Day Pricing

4.1 Ridership Objectives of Time-of-Day Pricing

All of the objectives set for time-of-day pricing by transit agencies hinge on achieving some desirable increase or redistribution in patronage. This chapter examines the ridership implications of time-of-day fares using both trend and statistical analyses.

As discussed in Chapter Three, the most common ridership objectives set for time-of-day pricing have been: 1) to stimulate, or maintain, ridership levels; and 2) to encourage shifts in usage from peak to off-peak periods. In some areas, ridership objectives have also pertained to particular groups (e.g. shoppers in the cases of Youngstown and Columbus, and non-commuters in the case of Binghamton). Because of data limitations, however, this chapter focuses principally on changes in total ridership as opposed to specific subpopulations.

4.2 Methodology

4.2.1 Measuring Ridership Impacts -- Trends and Models

An analysis of time-of-day pricing's ridership impacts would, ideally, use monthly patronage data disaggregated by peak and off-peak periods. In addition to fare levels, ridership changes would be related to service characteristics (broken down by time of day), as well as exogenous factors such as employment patterns, the price of gasoline, and seasonal influences. Also, the data would span several years surrounding the fare change. None of the properties studied had such comprehensive ridership and service tabulations. For most, only annual ridership and vehicle mileage data were available. In these cases, ridership impacts could not be measured in any rigorous way. Instead, trends in ridership between the year before and the year after the fare change were traced. An attempt also was made to correct the observed ridership changes to reflect the influence of service level adjustments.

For seven properties, however, suitable monthly data on ridership, fare, and service levels were available. Together with information on employment and gasoline prices, these data were used to estimate ridership models. Statistical models provide perhaps the best insights into time-of-day pricing's ridership impacts.

Finally, the unavailability of detailed data precluded any analysis of time-of-day pricing's impacts on the peak/off-peak distribution of transit usage for most properties. Several, however, had before-and-after passenger counts or ridership surveys from which this distribution could be estimated. Still others provided some relevant anecdotal evidence. Moreover, two systems had monthly ridership data disaggregated by time period, from which models could be developed. Based on this evidence, trend analysis and modeling techniques were also used to look at the impacts of time-of-day pricing on the peak/off-peak distribution

of ridership.

4.2.2 Evaluating Ridership Impacts

Ridership impacts of different types of time-of-day fare programs can be expected to vary. In the case of off-peak discounts, the key questions are how much overall ridership has increased, and the degree of fare sensitivity implied by this increase. Conversely, in the cases of peak surcharges and differential increases, concern is over measuring the relative decline in usage as well as the degree of fare sensitivity thereby suggested. And, regardless of the type of fare change, the incidence of ridership shifting from peak to off-peak is also of vital interest.

As a measure of fare sensitivity, the elasticity of demand which respect to fare (fare elasticity, for short) is used. This quantity is defined as the ratio of the proportional change in transit demand to the proportional change in fare.* The fare elasticity metric has been widely used in studies of transit ridership. Lago and Mayworm (1981) have compiled many of the elasticity estimates derived in past studies, and found the means of the values cited to be -0.25, -0.30, and -0.34 for large, medium-sized, and small cities,** respectively. In the analysis presented here, these values are used as standards against which the elasticities estimated from ridership impacts of time-of-day fare programs are assessed.

The next section traces trends in total ridership as well as changes in the distribution of passengers between peak and off-peak periods. Fare elasticities are also estimated. Section 4.4 presents ridership models developed for seven systems -- Allentown, Akron, Cincinnati, Columbus, Seattle, Orange County, and Denver. Point estimates of fare elasticities are estimated from these models. Concluding remarks complete the chapter.

4.3 Ridership Trends Associated with Time-of-Day Pricing

4.3.1 Trends in Overall Ridership Levels

Table 4.1 summarizes trends in total ridership associated with three types of time-of-day fare changes. Off-peak and midday discounts, it is recalled, aim to stimulate ridership. Since off-peak demand is believed to be fairly price-sensitive, average fare elasticities should be negative and numerically large. Differential increases and peak

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* The fare elasticity may be calculated in several different ways which yield slightly different results. Formulas used in computing these elasticities are discussed subsequently.

** Large cities are defined as those with populations over 1 million, medium cities are those with population between 500,000 and 1 million, and small cities are those with populations less than 500,000. See Mayworm, et al. (1980), p. 22.

Table 4.1

Trends in Total Ridership Levels Associated with Time-of-Day Pricing

Type of Fare Change	Transit Property	Adult Cash Fares[1/] Before Fare Change ($)	Adult Cash Fares[1/] After Fare Change ($)	Change in Average Fare[2/] (%)	Change in Vehicle Miles[2/] (%)	Observed Ridership Change[2/] (%)	Estimated Fare-Induced Ridership Change %/Fare Elasticity,[3/] Assuming Vehicle-Miles Elasticity of: 0.0	0.5	1.0	Fare Elasticity For Cities of Comparable Size[4/]
Off-Peak or Midday Discount	Akron[5/]	.40	.35 R .25 M	-13.0	21.9	16.7	16.7/-1.28	5.7/-0.44	-5.2/0.40[6/]	-0.30
	Boston[7/]	.25	.25 R .10 M	-7.6[8/]	N/A	-1.3[9/]	-1.3/0.16[5/]	N/A	N/A	-0.25
	Burlington	.35	.35 P .25 OP	-14.0[10/]	10.9	16.0	16.0/-1.14	10.6/-0.76	5.1/0.36	-0.34
	Erie	.30	.30 P .20 MD	-9.0	3.7	8.3	8.3/-0.93	6.5/-0.72	4.6/-0.51	-0.34
	Louisville	.50	.50 P .25 OP	-33.3	11.7	8.8	8.8/-0.29	3.0/-0.09	-2.9/0.09[6/]	-0.30
Differential Increase	Baltimore[7/]	.30	.40 P .35 P	27.1[11/]	-6.1[11/]	-14.1[11/]	-14.1/-0.52	-5.8/-0.41	-4.1/-0.29	-0.30
	Salt Lake City	.30	.50 P .40 OP	61.0	N/A	-13.0	-13.0/-0.21	N/A	N/A	-0.30
	Wilmington	.50	.60 R[12/] .50 M[13/]	55.0	-4.3	-25.9	-25.9/-0.47	-23.6/-0.43	-21.6/-0.39	-0.34
Peak Surcharge	Chapel Hill	.40	.50 P .40 OP	12.5[10/]	-8.0[14/]	-3.2	-3.2/-0.26	0.8/0.06[6/]	4.8/0.38[6/]	-0.34
	Minneapolis	.50/.60[15/]	.75 P .60 OP	28.6[15/]	6.2[15/]	-10.0[15/]	-10.0/-0.35	-6.9/-0.24	-3.8/-0.13	-0.25
	Sacramento	.50	.60 P .50 OP	10.0[9/]	-25.4	-14.6	-14.6/-1.46	-1.9/-0.19	10.8/0.11[6/]	-0.34
	Tacoma	.25	.50 P	30.4	4.8	-0.5	-0.5/-0.02	-2.9/-0.10	-5.3/-0.17	-0.34

1/ Codes used to describe time-of-day fares are: P - Peak; OP - Off-peak; R - Regular; M - Midday.

2/ Unless otherwise noted, changes are between year before and year after fare change. Average fare is computed by dividing total fare receipts by total number of passengers.

3/ Elasticity calculated by dividing estimated fare-induced ridership change by change in average fare.

4/ See text, page 52.

5/ Initial implementation, October, 1972. Changes are between 1972 and 1973.

6/ Positive fare elasticities imply that higher fares result in more riders, which is nonsensical. When a positive elasticity estimate is cited, it should be assumed either that factors other than fares and level of service are involved, or that an incorrect vehicle-miles elasticity is being assumed.

7/ Time-of-day pricing subsequently abandoned.

8/ Estimated using weighted average of regular and midday fares.

9/ Based on passenger counts taken the week before and the five weeks after the fare change.

10/ Estimated using average of peak and off-peak fares.

11/ Time-of-day pricing introduced in 1976. Changes are between 1975 and 1977.

12/ Base fare. Additional .20 charged for each of up to three zone crossings.

13/ Base fare. Additional .20 charged for all inter-zone trips.

14/ Change in vehicle-hours. Vehicle-miles data not available.

15/ Based on 1981 and 1983 data. Fare was .50 for first six months and .60 for last six months of 1981.

surcharges, on the other hand, could be expected to cause decreases in overall ridership. In these cases, however, peak period users, who are usually relatively price-insensitive to fare changes, bear the brunt of the fare increase. This, in combination with the fact that peak users may also shift their trips to the off-peak, suggests that the average fare elasticities associated with differential increases and peak surcharges will be quite small numerically.

Table 4.1 presents three different estimates of changes in ridership prompted by the introduction of time-of-day pricing. The use of more than one estimate reflects the uncertainty introduced by changes in level-of-service (as measured by the vehicle-mileage) which often occurred at the same time as the fare changes. The three estimates account for service as follows: the first assumes that ridership is not affected by the service changes, and therefore makes no correction; the second assumes a vehicle-miles elasticity of 0.5, i.e. that a 10% increase in vehicle-miles would result in a 5% rise in ridership; and the third estimate assumes a vehicle-miles elasticity of 1.0. Any of these estimates could, in certain circumstances, be the most appropriate. Mayworm et al. (1980) found that, in 23 studies of transit ridership in which estimates of vehicle-miles elasticities were derived, the mean was 0.64 and the standard deviation 0.30. Thus, the ridership change and elasticity estimates associated with a vehicle-mile elasticity of 0.50 are probably the most representative.

Of the five properties shown in Table 4.1 which have adopted off-peak or midday discounts, four appear to have experienced significant ridership gains as a result. The largest absolute ridership increases were registered by Akron and Burlington, while Burlington and Erie appear to have experienced the most fare-elastic ridership responses. Only in Boston did the discount seem ineffective in stimulating ridership.

In both Burlington and Erie, riders seem to have been more fare-elastic than is typical for cities of comparable size. This suggests that the discounts were more effective in boosting ridership than a uniform lowering of fares would have been. In the cases of Akron and Louisville, massive service increases at the time of the fare change make the assessment of ridership impacts difficult. Moreover, Louisville's elasticities indicate a ridership increase below what would be expected from a flat fare reduction.

Among the three properties which implemented differential increases included in Table 4.1, ridership consistently declined, albeit to varying degrees. Users seem to have been most fare sensitive in Wilmington and Baltimore. Only in the case of Salt Lake City does it appear that some ridership loss was averted by implementing a differential vis-a-vis an across-the-board fare increase. In the other cases, the fare elasticities are well within the normal range for cities of comparable sizes.

Finally, Table 4.1 also presents estimated elasticities for four properties which implemented peak surcharges. The largest ridership decrease occurred in Sacramento, a system which initiated extensive service cuts at around the same time as the fare change. Among the other

three systems, Minneapolis experienced the greatest initial loss in ridership and Tacoma the least. Expressed in terms of fare elasticity, ridership losses in Chapel Hill and Tacoma appear to be unusually low, while the loss experienced in Minneapolis appears to be moderate. In sum, two of the four properties seem to have averted ridership losses by adopting time-of-day pricing, while one appears to have incurred about the same loss as would have been expected by simply increasing flat fares, and in the fourth property ridership impacts cannot be assessed because of large scale service cutbacks.

4.3.2 Trends in Peak/Off-Peak Ridership Distributions

Changes in the peak/off-peak distribution of ridership associated with time-of-day pricing are summarized in Table 4.2. Regardless of the type of fare change, an increase in the off-peak share of total ridership is expected.

Among eight systems introducing either midday or off-peak discounts, the share of total ridership in off-peak periods increased in four cases: Burlington, Columbus, Rochester, and Spartanburg-Anderson. In the four other areas, discounts appear to have had little or no effect on the off-peak share. The average percentage discount in the former group is significantly larger than that in the latter group -- 47% versus 28%. If Duluth, with its particularly unusual discount program (see Appendix I.26) is excluded, the properties which experienced the greatest shifts in peak/off-peak ridership also have a relatively long designated midday discount period -- an average of 5.5 versus 4 hours. These comparisons suggest that large differentials and lengthy discount periods are important factors toward making discount programs effective in redistributing ridership.

Nine systems which have implemented time-of-day pricing by means of differential increases or peak surcharges are also included in Table 4.2. In general, these systems appear to have experienced slight increases in off-peak ridership shares following their fare changes. One notable exception is Chapel Hill, where the off-peak share has increased by almost 40%.* Sacramento, on the other hand, stands out as the only system for which a marked shift away from the off-peak has accompanied time-of-day pricing, probably as the result of concomitant service reductions.

In sum, of eight discount and nine surcharge or differential increase programs for which information is available, significant increases in the off-peak share of total usage accompanied four of the former and one of the latter. Also, in the case of the fare discounts, the degree of increase appears to be related to the size of the

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* Minneapolis, for which a ridership survey but not a ridership count, was available, is another possible exception, as 18% of survey respondents report that they have shifted usage time to the off-peak. It is difficult to interpret this result, however, without information concerning the proportion of trips which these respondents have rescheduled.

Table 4.2

Trends in Ridership Distribution Between Peak and Off-Peak Periods Associated with Time-of-Day Pricing

Type of Fare Change	Transit Property	Fare Differential ($)	Fare Differential (%)	Hours in which Lower Fares in Effect	Evidence of Change in Ridership Distribution between Peak and Off-Peak
Midday or Off-Peak Discount	Akron	.05	9	10 a.m.-2 p.m.	One-day on-board passenger counts before and after adoption of differential indicate no shift.
	Boston	.15	60	10 a.m.-1 p.m.	Passenger counts indicate percentage of riders during discount period increased from 12.4% the week before the fare change to an average of 13.3% the first five weeks after the change.
	Burlington	.25	33	9 a.m.-3 p.m.	88% of midday riders surveyed report they plan trips to take advantage of discount.
	Columbus	.35	58	9:30 a.m.-3 p.m.	Midday ridership up from 36% of 44% of total. Staff estimates 10% shift from peak to midday.
	Duluth[1]	2.00	21	All except 7:30-8 a.m.	Passenger counts and surveys indicate no shift.
	Rochester[1]	.15	38	10 a.m.-2:30 p.m.	Anecdotal evidence of significant shifts from peak to off-peak.
	San Francisco[1] (BART)	.10-.35	20	10 a.m.-3 p.m.	During one-month experiment, 37% of average weekday passengers rode during midday as compared with 36% in three-month period before and after experiment.
	Spartanburg-Anderson, SC	2/	60	9 a.m.-3 p.m.	Off-peak pass sales increased 100% over three-year period while overall ridership held steady.
Differential Increase	Orange County	.15	20	9 a.m.-3 p.m. After 6 p.m.	Passenger counts indicate an increase in off-peak share of total ridership from 44% to 46%.
	Wilmington	.10-.70[3/]	17-42[3/]	9 a.m.-3 p.m.	Passenger counts indicate increase in midday share of total ridership from 28.5% to 29.3%.
Peak Surcharge	Chapel Hill	.10	20	9:30 a.m.-3 p.m. After 6:30 p.m.	Passenger counts indicate increase in off-peak share of total ridership from 33% to 46%.
	Minneapolis	.15	20	9 a.m.-3:30 p.m. After 6:30 p.m.	Responding to ridership surveys, 18% of users report they have shifted usage to off-peak.
	Sacremento	.10	17	Before 6 a.m. 9 a.m.-3:30 p.m. After 6 p.m.	Passenger counts indicate off-peak share of total ridership was 63.9% in year prior to differential and 55% in year after differential was adopted.
	Seattle	.10	17	Before 6 a.m.[4/] 9 a.m.-3 p.m. After 6 p.m.	Ridership survey indicates a 4% shift of discretionary trips from peak to base period.
	St. Louis[2]	.10	17	Before 6 a.m. 9 a.m.-3 p.m. After 6 p.m.	Passenger counts indicate off-peak share of total ridership was 43.3% prior to differential, 43.8% when differential was in effect, and 43.1% after differential was abandoned.
	Tacoma	.25	50	Before 5 a.m. 9 a.m.-4 p.m. After 6 p.m.	Increase in off-peak share of total ridership from 44.6% to 47.5%.
	Washington Metrobus	.05	7	9:30 a.m.-3 p.m. After 6:30 p.m.	Increase in off-peak share of total ridership from 33.3 to 36.8%

1 Time-of-day pricing subsequently abandoned.

2 Discount applies to monthly passes only.

3 Differential depends on number of zone boundaries crossed.

4 Hours differ slightly for morning outbound and afternoon inbound trips.

differential and the length of the discount period.

4.4 Econometric Analysis of Ridership Impacts of Time-of-Day Pricing

4.4.1 Analytical Procedures

Seven of the transit properties studied had sufficient monthly time series data to enable ridership impacts of time-of-day pricing to be modeled. For all of these properties, regression equations were estimated to study ridership effects. In addition, two properties had ridership data disaggregated by peak and off-peak period so seperate models for each time period were developed.

The major virtue of econometric as opposed to the trend analysis is that the models systematically control for many of the factors which significantly influence ridership, and thereby isolate the effect of fare changes. In all models, monthly ridership levels (either total, peak, and off-peak) served as the dependent, or policy, variables. The independent variables include, in addition to variables pertaining to the fare structure, level of service (measured in terms of vehicle miles), gasoline price, total regional employment, total regional workforce, unemployment rate, day composition (a function of the number of workdays, Saturdays, Sundays, and holidays in the month), season of the year, and a secular trend adjustment.*

The variables used to represent fare structures differed. Average fare, calculated by dividing total farebox receipts by total revenue passengers, was usually employed in models of total ridership because passengers use a variety of different fare categories.** Models of peak and off-peak ridership used peak and off-peak fares instead of the average fare.*** Finally, several of the models of total ridership include

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* Gasoline price data were obtained from the Oil and Gas News, which publishes a weekly survey of gasoline prices for selected cities around the U.S. The "pump" price reported for the first week of the month for the nearest city included in the survey was used to develop the models. Monthly data on employment, workforce, and unemployment rate were obtained from the U.S. Census publication Employment and Earnings. The secular trend variable is set at 1 for the first month of the time series and then incremented by 1 with each succeeding month. Of the independent variables used in developing the ridership models, only those which are statistically significant were included in the final model specifications. The exclusion of statistically insignificant variables permits the coefficients of the remaining variables to be estimated with greater precision. See Chatterjee and Price (1977, pp. 195-196) for a discussion of the consequences of variable deletion.

** In the case of Cincinnati, the lack of revenue data necessitated the use of adult peak fare in place of average fare.

*** Ideally, both fares would be used in both models, reflecting the possibility that ridership in one period could be effected by fares in the other. The inclusion of both variables was, however,

dummy variables to reflect other features of a fare structure, such as the existence of a time-of-day differential.*

Model estimation was carried out using either ordinary least squares or, when necessary, the Cochrane-Orcutt first order autoregression procedure. The latter is called for when the Durban-Watson statistic reveals significant serial correlation between error terms. The reader is referred to Pindyck and Rubinfeld (1981, pp. 152-161) for a discussion of these estimation procedures.

The models are all of the single equation type. Ideally, simultaneous-equation models would have been developed, because ridership, fares, and service levels all influence one another. Simultaneous estimation, however, could not be carried out because of a shortage of pre-determined variables. The reliance upon single equation models implied that the "feedback" effects of ridership on fares and service levels were sufficiently weak to be excluded from the model structure. (See Pindyck and Rubinfeld, 1981, for further discussion on simultaneous-equation models.)

Fare point elasticities are used to measure the price sensitivity of riders at different points on the demand surface. To give a sense of both the magnitude and the range of this sensitivity around the mean fare and ridership values, tri-point elasticities were derived. Tri-point elasticities are calculated as follows. Let the ridership model be of the form:

$$Y_t = \beta_o + \sum_i^n \beta_i X_{it} + \varepsilon_t \tag{4.1}$$

where Y is the dependent variable, β is the intercept term, ε is a stochastic error term, and the X_i and β_i, respectively, are the independent variables and their associated linear coefficients. Let the variable X_j $(1<j<n)$ have a mean value $\overline{X}_j$ and a standard deviation σ_j, and let Y have a mean value $\overline{Y}$. The tri-point elasticities are then calculated as:

$$\eta = \frac{\overline{X}_j}{\overline{Y}} \tag{4.2}$$

$$\eta_j^+ = {}_j\frac{\overline{X}_j + \sigma_j}{\overline{Y} + \beta_j\sigma_j} \tag{4.3}$$

$$\eta_j^- = \frac{\overline{X}_j - \sigma_j}{\overline{Y} - \beta_j\sigma_j} \tag{4.4}$$

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prevented by the degree of collinearity between peak and off-peak fares encountered.

* In Orange County and Seattle, dummy variables were used to represent changes in a fare structure, taking on one value before the fare change and a second value after the change. In several other cases, a dummy variable for time-of-day fares could not be included because it was highly correlated with average fare.

η_j is the elasticity with respect to independent variable X_j (e.g., fare) calculated at the point of the means of each of the independent variables (see Pindyck and Rubinfeld 1981, p. 91). η_j^+ and η_j^- reflect the variation in elasticity as the jth coordinate of the point of evaluation varies from $X_j + \sigma_j$ to $X_j - \sigma_j$.

4.4.2 Analysis Results

In this section, ridership models and fare elasticity estimates are presented for seven areas -- Allentown, Columbus, Cincinnati, Denver, Orange County, Akron, and Seattle. Models of peak, off-peak, and total ridership are included for Allentown and Cincinnati, whereas only total ridership models are offered in the other five cases.

The seven areas present rich and varied contexts for studying the ridership impacts of time-of-day pricing. Two -- Allentown and Columbus -- introduced time-of-day pricing by means of an off-peak discount. Three others -- Cincinnati, Orange County, and Denver -- implemented differential increases whereby peak fares rose more than off-peak ones. Finally, Akron and Seattle instituted surcharges with Akron increasing non-midday fares and Seattle raising only peak fares. Moreover, the seven cases encompass a wide range of city sizes, geographic locations, and urban forms.

The following subsections present the models which were developed for each of the seven properties and discuss their implications. For all equations, R^2 represents the Coefficient of Determination (see Pindyck and Rubinfeld, 1981, p. 62). Also, the subscript t denotes time series observations. Finally, values in parentheses below each equation represent the probabilities that coefficients equal 0.

Allentown

The Lehigh and Northampton Transit Authority (LANTA), which serves the Allentown/Bethlehem, Pennsylvania urbanized area, provided the most extensive monthly ridership data among all of the systems studied. The data cover the period from April, 1971, fifteen months before time-of-day pricing was initiated, through February, 1983. When LANTA introduced an off-peak discount -- by lowering the off-peak fare from 40 to 25 cents -- in August, 1972, it began counting peak and off-peak ridership separately. Thus, the model for overall ridership was developed from monthly data beginning in April, 1971, while the peak and off-peak ridership models are based on data from August, 1972 onward.

LANTA's fare structure has undergone many changes since the early seventies. In April, 1971, a 35-cent flat fare existed. In November of that year, the fare was increased to 40 cents. In December, 1972, just four months after the introduction of the discount, the regular fare was increased to 45 cents and zonal surcharges (20 cents for one zone crossing, 25 cents for more than one) were introduced. In 1973, special senior citizen fares were introduced, leading to a change in passenger counting procedures whereby senior citizens were counted separately. Later in the same year, zonal surcharges were eliminated, and in 1975 the regular fare was lowered from 45 cents to 35 cents. Fares remained

stable for the next four years, until 1979, when both peak and off-peak fares were increased by a nickel, the first change in off-peak fares since 1972. A 10-cent increase to both fares in 1981 brought them to their current levels of 50-cents peak and 40-cents off-peak.* Thus, although time-of-day pricing was introduced as an off-peak discount at LANTA, succeeding years have witnessed peak surcharges, a peak fare reduction, and across-the-board increases as well.

The overall ridership model obtained for LANTA is shown in equation 4.5.

$$\begin{aligned}\hat{P}_t = 288 &+ \underset{(.00)}{0.74G_t} + \underset{(.10)}{5.0W_t} - \underset{(.00)}{14.4S_t} + \underset{(.00)}{4.1DC_t} + \underset{(.00)}{0.61T_t} + \underset{(.02)}{0.30M_t} \\ &- \underset{(.00)}{6.2F_t} + \underset{(.04)}{13.7ZD_t} - \underset{(.00)}{15.6SD_t} - \underset{(.00)}{49.7M_t}\end{aligned} \tag{4.5}$$

where $\hat{P}$ = Predicted monthly adult passengers (thousands)

G = Gasoline price (cents per gallon)

W = Winter dummy variable (= 1 for January, February, March and 0 otherwise)

S = Summer dummy variable (= 1 for June, July, and August)

DC = Day composition variable (weekdays - Sundays - holidays)

T = Secular trend variable (= 1 for January, 1971, = 2 for February 1971, etc.)

M = Monthly vehicle miles (thousands)

F = Average fare (cents)

ZD = Zonal fares dummy (= 1 for period when zonal surcharges were in effect and 0 otherwise)

SD = Senior citizen exclusion dummy (= 0 before June, 1973, when senior citizens began to be counted separately from other passengers, and 1 thereafter)

TD = Time-of-day fares dummy (= 0 before August, 1973, when time-of-day fares were initiated, and 1 thereafter)

$R^2 = 0.83$ N = 140 observations

The model coefficients were computed using first-order autoregressive

* Various pre-payment options, including 10-, 20-, and 40-ride tickets and monthly passes, have also existed over this period.

estimation, as significant negative serial correlation of error terms was discovered when ordinary least squares was used. The R-square of 0.83 indicates a reasonably good fit, and all coefficients, with the exception of that for the winter dummy variable, are significant at the .05 probability level.

Equation 4.5 indicates that, ceteris parabus, LANTA's adult ridership increased with the passage of time, and in response to higher gas prices and expanded services, while it declined in response to higher fares. Perhaps most relevant to this research is the negative and highly significant coefficient on the time-of-day fares dummy variable, which implies that, holding average fare as well as all other variables constant, time-of-day pricing has caused LANTA to lose riders since 1972. It is also noteworthy that LANTA's ridership appears to have been unusually fare-elastic, with average fare elasticities in the neighborhood of -1.0. The tri-point elasticities for average fare, gasoline price, and monthly vehicle-miles are presented in Table 4.3.

Table 4.3

Tri-Point Elasticity Estimates[1],
LANTA Total Ridership Model

Variable	η^o	η^+	η^-
Average Fare	-1.00	-1.11	-0.89
Vehicle Miles	0.21	0.24	0.18
Gasoline Prices	0.25	0.37	0.13

1 η^o is the midpoint estimate. η^+ is defined in equation 4.3 as a one standard deviation positive adjustment. η^- is shown in equation 4.4 as a one standard deviation negative adjustment.

Equation 4.5 warrants two caveats. First, the relatively small number of observations (sixteen) which cover the period in which uniform fares were in effect (April, 1971 to July, 1972) may have resulted in an exaggeration of the negative influence of time-of-day fares.* Second, the fact that a major increase in fares, including an increase in peak rates and the imposition of zonal surcharges, occurred four months after the initiation of time-of-day pricing means that ridership changes over this period occurred in response to multiple revisions in the fare structure. This makes the relative affect of each fare change difficult to assess statistically. The apparent negative impact of time-of-day fares on Allentown's ridership levels suggested by equation 4.4 should, therefore, be interpreted cautiously.

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* This is because variations in ridership are magnified when there is a large disparity in the distribution of observations over the two possible values of a dummy variable.

Interestingly, the separate models for peak and off-peak ridership are consistent with the inference from equation 4.4 that time-of-day fares have suppressed ridership levels. The models for peak and off-peak ridership are presented in equations 4.6 and 4.7 respectively.

$$\hat{P}^p_t = 166 + \underset{(.00)}{0.70G_t} + \underset{(.07)}{5.0W_t} - \underset{(.00)}{15.5S_t} + \underset{(.00)}{3.8DC_t} - \underset{(.00)}{3.31F^p_t} \qquad (4.6)$$

$R^2 = 0.78$

$$\hat{P}^o_t = 26.6 + \underset{(.00)}{4.97W_t} + \underset{(.00)}{5.25SP_t} + \underset{(.00)}{0.91DC2_t} + \underset{(.02)}{0.47T_t} + \underset{(.00)}{0.29M_t} - \underset{(.00)}{1.70F^o_t} \qquad (4.7)$$

$R^2 = 0.64$

where, in addition to the variables defined in Equation 4.5,

$\hat{P}^p$ = Predicted monthly adult peak passengers (thousands)

$\hat{P}^o$ = Predicted monthly adult off-peak passengers (thousands)

F^p = Peak fare* (cents)

F^o = Off-peak fare (cents)

SP = Spring dummy variable (= 1 for March, April, May and 0 otherwise)

DC_2 = Off-peak day composition variable (Saturdays + Sundays + holidays)

N = 140 observations

The coefficients of both models were again calculated using first-order autoregressive estimation, as significant positive serial correlation of error terms was encountered. The R-square values of .78 and .64 indicate moderately good fits.

Note that equations 4.6 and 4.7 contain no fare "cross terms", i.e., peak fare is not included in the off-peak model and vice versa. This was because of high muticollinearity between the two variables. Thus, fare cross-elasticities for assessing the incidence of ridership

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* Peak fare is defined as total revenue collected from peak period users (including ticket and pass sales as well as cash fares) divided by total users.

shifting between peak and off-peak periods could not be estimated.

The tri-point elasticity estimates derived from these models are presented in Table 4.4. Curiously, fare elasticities associated with peak demand are higher than those for off-peak demand. This result, while contrary to the findings of most researchers, may help to explain why Allentown's discount fares have witnessed decreases in ridership levels: the highest, non-discounted, fares are charged when demand is the most fare sensitive. These findings might also reflect the fact that LANTA's riders are more price-sensitive at the high range of fare values (represented by peak charges) than the lower end (represented by off-peak charges). Overall, these results suggest that elimination of LANTA's time-of-day differential might have a positive effect on both ridership levels and farebox returns.

Table 4.4

Tri-Point Elasticity Estimates[1],
LANTA Peak and Off-Peak Ridership Models

Variable	Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
Fare	-0.85	-0.67	-1.01	-0.96	-0.71	-0.45
Vehicle Miles	A	0.56	A	0.58	A	0.62
Gasoline Price	0.32	B	0.44	B	0.22	B

[1] See note for Table 4.3 for definitions of η^o, η^+, and η^-.

A Variable not included in peak ridership model.

B Variable not included in off-peak ridership model.

In summary, the evidence suggests that LANTA's discounted off-peak fares have, all other things being equal, resulted in ridership losses. This finding, it should be remembered, hinges upon ridership comparisons for several structural variations in pricing, each of a different duration and two of which occurred around the same time as the advent of time-of-day pricing. Nonetheless, this result is consistent with the fare elasticities derived from the peak and off-peak ridership models, which raise the possibility that LANTA's peak period riders may be even more sensitive to fares than its off-peak users. LANTA may therefore be an example of a transit system whose market characteristics are, for some unexplained reason, ill-suited to the discounting of off-peak fares.

Columbus

The Central Ohio Transit Authority (COTA) adopted time-of-day pricing in June, 1981, when the midday fare was lowered from 60 cents to 25 cents outside of the CBD, and eliminated entirely within the CBD. (See

Appendix I.8 for further discussion of COTA's fare structure.) Monthly ridership data for the period from January, 1980 to October, 1982 were used in estimating the following model:

$$\hat{P}_t = 2172 + \underset{(.00)}{25.0DC_t} - \underset{(.00)}{4.46T_t} - \underset{(.00)}{28.6F_t} \qquad (4.8)$$

where $\hat{P}^P$ = Predicted monthly adult non-express passengers, including revenue passengers, free fare zone passengers, and midday pass passengers (thousands)

DC = Day composition variable (weekdays - Sundays - holidays)

T = Secular trend variable (= 1 for January, 1980, = 2 for February, 1980, etc.)

F = Average fare (cents)

R^2 = .99, Durban - Watson statistic = 1.64, N = 34 observations

Ordinary least squares was used to estimate the equation. The R-square of .99 indicates an extremely good fit, and all coefficients are statistically significant.

Note that equation 4.8 does not contain any explicit reference to time-of-day fares, such as a dummy variable. This is because the onset of time-of-day fares occasioned a major reduction in average fare levels, so that average fare and a time-of-day dummy variable would be highly collinear. Therefore, in order to interpret equation 4.8, it is necessary to assess the degree of fare sensitivity displayed by COTA's patronage to the midday fare reduction. The tri-point fare elasticities, η^o, η^+, and η^-, are -0.94, -1.19, and -0.49 respectively, suggesting that COTA's customers were quite sensitive to the substantial midday discounts. Presumably, the strong reaction of COTA's users to the discount stems from the targeting of lower fares as off-peak markets as well as the large absolute and relative size of the discounts. Presumably, the high elasticity stems from the targeting of the reductions at off-peak riders, as well as the large absolute and relative size of the discounts.

A final observation concerns the large variation between the values for η^o, η^+, and η^-. The implication is that fare elasticities vary with fare level. Such variation is implicit in the use of a linear ridership model, and therefore represents an assumption and not an empirical result. If, however, one accepts this assumption, then the elasticity values have interesting implications for COTA's fare policy. The η^+ value approximates the fare elasticity prior to the midday discounts, while the η^- corresponds to the elasticity after the discounts were adopted. Thus, the fact that η^- is far lower than η^+ implies that the off-peak discount is subject to rapidly diminishing returns. In effect, this means that while COTA's initial reduction in

midday fares was an extremely cost-effective way of increasing ridership, a further reduction would produce far less spectacular results.

Cincinnati

The Southwest Ohio Regional Transit Authority (SORTA), serving the Cincinnati metropolitan area, has differentiated fares by time-of-day since 1978. (See Appendix I.7 for a discussion of the development of SORTA's fare structure.) Monthly ridership data from 1973 through 1982 were available for modeling purposes. In addition, data for the years 1980-82 were disaggregated by time period. SORTA data thus supported the development of overall, peak, and off-peak ridership models.

In August of 1973, SORTA's adult cash fare was set at a flat 25 cents. Since that time, there have been three major changes. Time-of-day pricing was introduced by means of a differential increase in 1978, when the peak and off-peak fares were raised to 35 and 30 cents, respectively. These fares were increased to 50 cents and 40 cents in 1981, and to 60 cents and 50 cents in July 1982. Thus, the first five years of the time series is a period of uniform fares, while during the subsequent five years a time-of-day differential has existed.

There were two problems with the SORTA data. First, the lack of suitable revenue data prevented the calculation of average fares. Consequently, peak fare was used as an indicator of average fare.* Second, SORTA's fares over the period when time-of-day pricing was in effect were higher than during the period of uniform pricing, resulting in a high degree of multicollinearity between peak fare and a time-of-day fares dummy variable. It was therefore necessary to exclude the dummy variable from the model.

The model for overall ridership estimated from the 1973-82 data is shown in equation 4.9.

$$\hat{P}_t = \underset{}{-3253} + \underset{(.00)}{5.3E_t} + \underset{(.00)}{150W_t} - \underset{(.00)}{343S_t} + \underset{(.00)}{0.32M_t} - \underset{(.00)}{9.8F_t^p} \qquad (4.9)$$

where $\hat{P}$ = Predicted monthly revenue passengers (thousands)

E = Total regional employment (thousands)

W = Winter dummy variable (= 1 for January, February, March and 0 otherwise)

S = Summer dummy variable (= 1 for July and August and 0 otherwise)

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* Peak fare is a good indicator of average fare since peak fare increases have always been accompanied by off-peak increases. Thus an increase in peak fare entails an increase in average fare.

M = Monthly vehicle miles (thousands)

F^P = Adult fare during peak period (cents)*

$R^2 = .89$, Durban - Watson statistic = 1.60, N = 111 observations

The R-square of .89 indicates a good fit, and all coefficients are highly significant. Overall, the model suggests that ridership rose as transit services and regional employment expanded from 1973 to 1981, but dropped with higher fares and during the summer months over the same period.**

The tri-point elasticities computed from equation 4.9 are presented in Table 4.5. The peak fare elasticity estimates are quite low,*** suggesting that SORTA lost very little ridership as a result of its 1978, 1981, and 1982 fare increases. This inelastic response may in part reflect the use of differentiated fares, although it must also be remembered that off-peak fares increased significantly between 1978 and 1982. Thus, SORTA's riders appear to have been fairly insensitive to both higher peak and higher off-peak fares.**** In contrast, demand elasticities were unusually high with respect to vehicle miles. This disparity between fare and service elasticities, although somewhat exaggerated, is consistent with what has generally been found by other investigators.

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* From 1973-1978 this was the same as the regular adult base fare.

** The lower ridership during the summer results from the inclusion of school trips in the ridership data.

*** Note that the elasticity is for overall ridership with respect to peak fares. Nonetheless, it is a reasonable approximation of average fare elasticity given the history of SORTA's fare structure.

**** One cause of the low elasticity may be that less fare sensitive groups, such as students and the elderly, are counted in the overall ridership totals.

Table 4.5

Tri-Point Elasticity Estimates[1],
SORTA Total Ridership Model

Variable	η^o	η^+	η^-
Peak Fare	-0.134	-0.178	-0.091
Vehicle Miles	1.23	1.33	1.12

1 See note for Table 4.3 for definitions of η^o, η^+, and η^-.

The models of peak and off-peak ridership developed from the 1980-82 data are shown in equations 4.10 and 4.11.

$$\hat{P}^p_t = 156 + \underset{(.00)}{59S_t} + \underset{(.00)}{0.087TM_t} - \underset{(.00)}{5.1F^p_t} \qquad (4.10)$$

R^2 = .83, Durban-Watson statistic = 1.83

$$\hat{P}^o_t = 484 - \underset{(.00)}{4.00G_t} + \underset{(.00)}{70.1TW_t} - \underset{(.00)}{15.4F^o_t} \qquad (4.11)$$

R^2 = .88, Durban-Watson statistic = 1.77

where, in addition to the variables defined in Equation 4.9,

$\hat{P}^p$ = Predicted monthly adult peak passengers* (thousands)

$\hat{P}^o$ = Predicted monthly adult off-peak passengers* (thousands)

G = Gasoline price (cents/gallon)

F^o = Off-peak fare (cents)

N = 36 observations.

* The peak and off-peak ridership models are based on ridership totals which include only adult users paying regular fares.

Ordinary least squares was used to estimate these equations. The R-square values of .83 and .88 indicate that both models fit the data well. Again, all coefficients are highly significant.

As in the case of the Allentown, peak/off-peak ridership models do not include fare "cross terms" because of the high correlation between peak and off-peak fares. Thus it is again impossible to draw any inferences concerning the incidence of shifting from one fare period to another.

The tri-point elasticities computed from these models appear in Table 4.6. These estimates suggest that the fare elasticity for off-peak riders is over twice that for peak riders, a result which is consistent with the literature. The table also reveals that peak riders are most sensitive to level of service, while off-peak users seem most concerned about fare levels, although they also attach some importance to both service levels and gasoline prices. The apparent disparity in service sensitivity between the two user groups is difficult to interpret because information on the peak/off-peak distribution of vehicle miles is not available.

Table 4.6

Tri-Point Elasticity Estimates[1], SORTA Peak and Off-Peak Ridership Models

	η^o		η^+		η^-	
Variable	Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
Fare	-0.31	-0.69	-0.40	-0.98	-0.22	-0.47
Vehicle Miles	1.10	A	1.09	A	1.10	A
Gasoline Price	B	0.58	B	0.60	B	0.57

1 See note for Table 4.3 for definitions of η^o, η^+, and η^-.

A Variable not included in off-peak ridership model.

B Variable not included in peak ridership model.

It is instructive to use the peak and off-peak ridership equations to predict the ridership which might result under alternative SORTA time-of-day fare scenarios. To do so, average values for other significant variables may be assumed, so that ridership becomes a function of fare only. The simple bivariate equations which result are:

$$P_t^p = 1010 - 5.1F_t^p \tag{4.10A}$$

and

$$P_t^o = 1454 - 15.4F_t^o \tag{4.11A}$$

Expected results of various SORTA fare scenarios are presented in Table 4.7.

Table 4.7

Predicted Ridership, Revenue, and Average Fare
Under Different Fare Structures

Fare Scenario		Ridership (000)			Revenue ($000)			Average
Peak	Off-Peak	Peak	Off-Peak	Total	Peak	Off-Peak	Total	Fare ($)
.60	.50	704	684	1388	422	342	764	0.55
.65	.45	678	761	1439	441	342	783	0.54
.70	.40	653	838	1491	457	335	792	0.53
.75	.35	628	915	1543	471	320	791	0.51

This sensitivity testing suggests that SORTA could increase both overall ridership and overall farebox revenue by raising the peak fare from 60 cents to 70 cents and lowering the off-peak from 50 cents to 40 cents. A further increase in the differential would, according to the model, cause an increase in ridership but some decrease in farebox revenue. In that SORTA's primary objectives in maintaining time-of-day fare differentials in recent years has been to increase revenues and encourage ridership shifts, this analysis suggests that an optimal differential would be about 30 cents. If achieving a balance in ridership levels between time periods was of concern, then a smaller differential might be called for. These results are noteworthy in that SORTA officials are currently contemplating a widening of the current 10 cents differential. (See Appendix I.7 and Chapter 8.2 for discussion of this issue in Cincinnati.)

In sum, SORTA's ridership models suggest that time-of-day pricing has enabled SORTA to raise fares with minimal losses in ridership. They also suggest that SORTA could probably increase farebox returns and overall ridership even more by widening the current 10 cents differential.

Denver

Denver's Regional Transit District (RTD) has differentiated fares by time-of-day since its inception in 1973. The most recent differential was introduced in June, 1981, when adult peak fares rose from 50 to 70 cents while fares in the off-peak increased from 25 to 35 cents.* The fare change, amounting to 40% in both fare periods, marked RTD's fifth time-of-day fare structure. (See Appendix I.9 for a more detailed description of Denver's time-of-day fare program and its development.)

Two years worth of ridership data, spanning 1980 and 1981, were available for investigating the ridership impacts of RTD's latest fare increase. Equation 4.12 was estimated from the data.

$$\hat{P}_t = 159 + \underset{(.00)}{28W_t} - \underset{(.00)}{13S_t} + \underset{(.00)}{7.4DC_t} + \underset{(.00)}{3.1T_t} - \underset{(.00)}{2.2F_t} \qquad (4.12)$$

where $\hat{P}$ = Predicted total monthly passengers (thousands)

W = Winter dummy variable (= 1 for January, February, March and 0 otherwise)

S = Summer dummy variable (= 1 for July, August, September and 0 otherwise)

DC = Day composition variable (workdays - Sundays - Holidays)

T = Secular trend variable (= 1 for January 1980, = 2 for February 1980, etc.)

F = Average fare (cents)

R^2 = .92, N = 24 observations

Model coefficients were derived using first-order autoregressive estimation, as significant negative serial correlation of error terms was found. The R-square of .92 indicates a good fit, and all coefficients are highly significant.

The tri-point fare elasticities -- η^o, η^+, and η^- -- are -0.22, -0.26, and -0.18 respectively. These values are quite typical for a city of Denver's size. Mayworm et al. (1981), for example, cite -0.24 as the mean fare elasticity for urban areas with populations over 1 million. The estimates are also slightly lower than the -0.28 off-peak

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* In the city of Boulder, the time-of-day differential was smaller, with peak and off-peak fares set at 50 and 35 cents, respectively. While Boulder ridership is included in the data used for modeling, it comprises only about 6% of the total.

fare elasticity observed in Denver's 1978-79 off-peak free fare demonstration program.* All in all, it appears that the ridership impacts to RTD's 40% across-the-board increase in time-of-day fares is quite comparable to what would be expected from a similar increase in flat fares.

Orange County

Orange County Transit District (OCTD) initiated time-of-day fares in June, 1981. (See Appendix 4.13 for a more detailed description of OCTD and its fare history.) The ridership model estimated for OCTD is based upon monthly data spanning the period January, 1979 to September, 1983. During this time, there were two major fare increases. In September, 1980, the flat 35 cents fare was raised to 50 cents. When time-of-day fares were adopted nine months later, the peak fare was increased to 75 cents and the off-peak rose to 60 cents.**

A ridership model which included average fare plus a time-of-day fare dummy variable was initially developed from the monthly time series. This initial model indicated that average fare was significant in explaining ridership trends but that the fare differential itself was not. These variables, however, were found to be highly intercorrelated (r =.91). Consequently, a second model was formulated, this time replacing the average fare variable with a second dummy variable which took the value 0 until the September, 1980 fare increase, and the value 1 thereafter. This model is shown below:

$$\hat{P}_t = 166 + \underset{(.00)}{18.0DC_t} + \underset{(.00)}{0.54M_t} - \underset{(.03)}{104D1_t} - \underset{(.01)}{101D2_t} \qquad (4.13)$$

where $\hat{P}$ = Predicted monthly adult revenue passengers (thousands)

DC = Day composition variable (= workdays - Sundays - Holidays)

M = Monthly vehicle miles (thousands)

D1 = Dummy variable for first fare increase (= 0 before the first fare increase in September, 1979 and 1 thereafter)

D2 = Dummy variable for second fare increase (= 0 before the second fare increase in June, 1980 and 1 thereafter)

R^2 = .59, N = 44 observations

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* DeLeuw, Cather and Company, 1979.

** OCTD also differentiates fares on dial-a-ride van services, charging $1.50 during peak hours and $1.25 during the off-peak. The model, however, considers only regular, fixed route services.

The coefficients of equation 4.13 were derived using first order autoregressive estimation, as significant positive serial correlation of error terms was found. The R-square of .59 indicates that the model has only moderate explanatory power, however all coefficients are in keeping with expectation and significant at the .05 level.

The equation indicates that about 104,000 rides per month were lost as a result of the flat fare increase in September, 1980, and that the switch from flat to differentiated fares, along with the associated fare increase in 1981, cost the system an additional 101,000 monthly passengers. To interpret these results, the average ridership and fare for each of the three time periods shown in Table 4.8 are relevant. These data allow average fare elasticities to be estimated for each of OCTD's two fare increases. The estimates are presented in Table 4.9.

Table 4.8

OCTD Average Fare and Ridership, January, 1979 to September, 1983

Time Period	Average Fare	Average Ridership (thousands)
1/79 - 9/80	.35	926
10/80 - 6/81	.49	910
7/81 - 9/83	.66	891

Table 4.9

OCTD Average Fare Elasticity Calculations

Date of Fare Increase	Average Fare Change (%)	Ridership Change (%)	Average Fare Elasticity
9/80	40	-11	-0.28
6/80	35	-11	-0.31

These elasticity estimates are slightly higher than those derived by consultants from on-board ridership surveys conducted in 1979 and 1981 -- -0.23 for the peak and -0.28 for the off-peak.* Overall, it appears

* See Charles River Associates (1981).

that OCTD passengers were comparably sensitive to the differential increase in 1981 and the 1980 flat fare hike. One can infer, then, that OCTD did not avert ridership loss by adopting time-of-day fares in 1981. On the other hand, it appears that changes in average fare, not the time-of-day fare structure itself, led to lower OCTD patronage over the 1980-82 period.

Akron

The Akron Metro Transit Authority (Metro) became one of the first properties in the U.S. to adopt time-of-day fares when, in 1972, fares were lowered to 25 cents during the midday and 35 cents during all other hours. Metro is also one of only two American properties which abandoned and then reinstated time-of-day fares. In February, 1981, fares went from 40 cents base and 30 cents midday to a flat 50 cents. In January, 1982, the time-of-day differential was brought back -- this time by means of a non-midday surcharge -- by raising the fare to 55 cents during the most hours while leaving the midday fare unchanged. A second nickel increase to non-midday fares in January, 1983, brought the time-of-day differential to 10 cents. (See Appendix I.1 for a more detailed discussion of Akron Metro and its fare history.)

Monthly ridership data for Metro were available for the period January, 1980 through February, 1983. Equation 4.14 was derived from these data.

$$\hat{P}_t = 488 - \underset{(.00)}{62S_t} + \underset{(.00)}{1.0M_t} - \underset{(.00)}{7.5F_t} - \underset{(.00)}{25TD_t} \tag{4.14}$$

where $\hat{P}$ = Predicted monthly revenue passengers (thousands)

S = Summer dummy variable (= 1 for July and August and 0 otherwise)

M = Monthly vehicle miles (thousands)

F = Average fare (cents)

TD = Time-of-day fares dummy (= 1 before February, 1981 and from January, 1981 onward; = 0 otherwise)

R^2 = .86, Durban-Watson Statistic = 1.68, N = 36 observations

Ordinary least squares was used to estimate the equation. The R-square of .86 indicates a fairly good fit, and all coefficients are highly significant. The fare tri-point elasticities of -0.69, -0.55, and -0.43 (for η^o, η^+, and η^-, respectively) are significantly greater than the average figure of -0.30 cited by Mayworm, et al. (1980) for cities of comparable size.

The negative, statistically significant coefficient on the dummy variable TD suggests that the time-of-day differential has caused ridership losses, controlling for average fare. A closer look at the data provides a two-fold explanation for the negative coefficient: first, the February, 1981 ridership increase, in which the time-of-day differential was eliminated, had only a slight negative impact on Metro's ridership but was accompanied by a substantial increase in average fares; second, the January, 1982, fare increase, which was much smaller and included a return to time-of-day pricing, coincided with a substantial ridership decline. The model uses time-of-day pricing to account for this disparity, implying that Akron's elimination of the differential helped mitigate the ridership losses brought on by the 1981 increase; on the other hand, the differential's reinstatement accentuated the ridership decrease stemming from the 1982 fare hike.

It is unlikely that time-of-day pricing accounts for the difference in ridership impacts associated with Metro's 1981 and 1982 fare increases. More probably, exogenous influences omitted in the analysis were at work. Lower gasoline prices and a depressed economy during 1982 would seem to be likely explanations, although both gasoline prices and economic indicators (total employment and unemployment rate) were found to be statistically insignificant. Another possible explanation is that Metro's 1981 fare increase was more readily tolerated because it was the first in several years.

In sum, Akron Metro's time-of-day fares have had no discernible stimulating effect on overall ridership levels. In part, this is because full fares are charged during all but weekday, midday hours. Aside from this, it appears that significant, albeit unexplained, factors triggered a ridership decline over 1980-82, obscuring any positive impact which the differential may have had.

Seattle

Seattle Metro initiated time-of-day pricing in February, 1982, by increasing its peak fare from 50 to 60 cents. Monthly ridership data from June, 1979 through February, 1983 were used to estimate the model. In addition to the 1982 peak surcharge, this period includes a flat fare increase from 40 to 50 cents in June, 1980. (See Appendix I.16 for a more detailed description of Seattle Metro and its fare structure.)

Seattle Metro's fare history precluded the use of a time-of-day dummy variable in the ridership model. As in the case of Orange County, such a variable was found to be strongly correlated with fare levels. Consequently, equation 4.15, in which both of Metro's fare increases are represented as dummy variables, was developed. The model is shown in equation 4.15.

$$\hat{P}_t = 358 + \underset{(.04)}{148W_t} - \underset{(.00)}{176S_t} + \underset{(.00)}{2.05M_t} - \underset{(.00)}{672D1_t} - \underset{(.00)}{258D2_t} \qquad (4.15)$$

where $\hat{P}$ = Predicted total monthly revenue passengers (thousands)

W = Winter dummy variable (= 1 for January, February, March and 0 otherwise)

S = Summer dummy variable (= 1 for July, August, September and 0 otherwise)

M = Monthly vehicle miles (thousands)

D1 = Dummy variable for first fare increase (= 0 before the first fare increase in June, 1980 and 1 thereafter)

D2 = Dummy variable for second fare increase (= 0 before the peak surcharge in February, 1982 and 1 thereafter)

R^2 = .72, Durban-Watson Statistic = 2.58, N = 24 observations

The model was estimated using ordinary least squares. The R-square of .72 indicates a moderately good fit, and all coefficients are significant at the .05 probability level.

The coefficients on D1 and D2 imply that Seattle Metro lost about 672,000 and 258,000 riders from the 1980 and 1982 fare increases respectively. Average fare and ridership data for the months before the first fare change, between the first and second fare changes, and after the second fare change are presented in Table 4.10. Fare elasticities were estimated from these data and are shown in Table 4.11. They suggest that Seattle Metro's ridership losses from the two increases reflect about the same degree of fare sensitivity. Although a smaller ridership loss resulted from the 1982 fare hike, the increase in average fare was also smaller.*

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* Seattle Metro conducted a before-and-after ridership survey to assess the ridership impacts of the 1982 fare increase. The survey findings are in some disagreement with the model results. See Appendix I.16 for a discussion.

Table 4.10

Seattle Metro Average Fare and Ridership,
June, 1979 to April, 1983

Time Period	Average Fare	Average Ridership (thousands)
6/79-5/80	0.37	5,351
7/80-1/82	0.47	5,462
2/82-4/83	0.51	5,247

Table 4.11

Seattle Metro Fare Elasticity Calculations

Date of Fare Increase	Average Fare Change (%)	Ridership Change (%)	Average Fare Elasticity
6/80	27.0	-12.6	-0.47
2/82	8.5	-4.7	-0.55

4.5 Concluding Remarks

The preceding sections reveal that the ridership impacts experienced by U.S. transit properties which have implemented time-of-day pricing are quite varied. This diversity is reflected in Tables 4.12 and 4.13, which summarize the apparent impacts on total ridership levels and the peak/off-peak distribution of ridership.

In Table 4.12, 19 properties are classified according to how time-of-day fares appear to have affected total ridership levels, controlling for vehicle mileage and average fare. The classification is made on the basis of the ridership models and comparisons between measured and typical fare elasticities shown in Table 4.1. It should be stressed that the results presented are based on incomplete data and are therefore by no means definitive. Overall, the table suggests that the impacts of time-of-day pricing on total ridership have been mixed. One can infer that a host of economic, political, and environmental factors, not all of which can be controlled through local policies, have influenced ridership outcomes in most areas.

There is some indication that off-peak and midday discounts have been more successful in bolstering ridership levels than peak surcharges and differential increases have been in forestalling patronage losses.

This is consistent with the notion that time-of-day pricing is more palatable when sold to the public as a discount rather than a surcharge, an insight marketing analysts seem to embrace (see Chapter Seven). This research suggests that peak users may be more sensitive to fare increases when they're limited to peak hours rather than when they're across-the-board. Systems which are considering peak surcharges should thus attend carefully to the issue of how to avoid alienating their "bread and butter" users.

Table 4.13 classifies properties according to the apparent impact of time-of-day pricing on the peak/off-peak distribution of ridership. Again, the impacts seem mixed, with 11 of the 18 properties for which information was available appearing to have experienced an evening out of demand. Evidence suggests that discount programs may induce such shifts more than differential increases and surcharges. As mentioned in Section 4.2, there is some indication that the size of the discount and the length of the midday low fare period are positively correlated with the incidence of shifting.

There remains a need for further research into the ridership impacts of time-of-day transit pricing. Our understanding of how fares in one period affect ridership an another period is especially limited. Further development of time-of-day disaggregated ridership models, and exploration of the marketing and implementation factors which condition the ridership impacts of time-of-day fares, is also needed. Such research may ultimately allow transit systems to tailor time-of-day fare structures specifically to their individual ridership and revenue objectives. In the meantime, although time-of-day pricing certainly has great potential to assist transit systems in meeting their objectives, our understanding of its role vis-a-vis other influences remains incomplete.

Table 4.12

Apparent Impacts of Time-of-Day Pricing on Total Ridership, Controlling for Average Fare and Level of Service

Type of Fare Change	Increase	Decrease	Little or Uncertain
Off-Peak or Midday Discount	Burlington Columbus[1] Erie	Allentown[1] Boston	Akron[2] Louisville
Peak Surcharge or Differential Increase	Chapel Hill[1] Cincinnati[1] Salt Lake City Tacoma	Akron[1,3] Baltimore Wilmington	Denver[1] Minneapolis Orange County[1] Sacramento Seattle[1]

[1] Based on Ridership Model

[2] Initial Implementation, October, 1972

[3] Re-implementation, February, 1981

Table 4.13

Apparent Impacts of Time-of-Day Pricing on Peak/Off-Peak Distribution of Ridership

Type of Fare Change	Evidence of Substantial Redistribution	Evidence of of Some Redistribution	Evidence of Little or No Redistribution
Off-Peak or	Burlington	Allentown[1]	Duluth
Midday Discount	Columbus Spartanburg-Anderson	Boston Rochester	San Francisco (BART)
Peak Surcharge Differential Increase	Chapel Hill	Cincinnati[1] Minneapolis Seattle Tacoma	Akron[2] Orange County Sacramento St. Louis Washington Wilmington

[1] Based on Ridership Model

[2] Re-implementation, February, 1981

Chapter Five

Financial and Productivity Implications of Time-of-Day Programs

5.1 Introduction -- Performance Objectives

Besides stimulating shifts in ridership, many time-of-day fare programs were also initiated with the objectives of upgrading financial and operating performances. Chapter Three identified the objective of "increasing revenue yields" as the second most frequently cited reason for differentiating peak and off-peak fares -- the primary aim in nine areas and secondary one in two areas. As would be expected, the "revenue" objective was cited by systems which introduced either peak surcharges or differential increases. Another performance objective set forth by agencies was to "recover higher shares of costs" -- identified by seven systems, all of whom introduced surcharge or differential increase programs, as a primary or secondary reason. Moreover, a number of agencies volunteered that this objective was set directly in response to proposed federal cuts in operating assistance.

Although these two financially-related objectives were the only ones cited which dealt directly with efficiency concerns (besides the previously discussed ridership ones), there are a number of other performance benefits which might also be expected. As discussed in Chapter Two, time-of-day pricing could potentially result in a reduction in peak fleet size due to ridership shifting. Although the previous chapter found little conclusive evidence of this, it's still instructive to look at changes in such variables as peak-to-base vehicle ratios to see if time-of-day pricing has been associated with a more efficient deployment of vehicles throughout the day. Likewise, significant reductions in peaking could ultimately translate into reductions in the size of a property's work force, though admittedly this would likely be an indirect, secondary impact which would only occur in tandem with other major efficiency improvements. Changes in such traditional performance indicators as unit costs and revenues (e.g., expense/vehicle-mile and revenue/vehicle-mile), labor productivity (vehicle-miles/employee), and vehicle utilization (revenue-hours/vehicle) might also be anticipated.

It's important to address the effectiveness of time-of-day fare programs in meeting more secondary objectives set for them. For instance, the objective of stimulating downtown retail activities mentioned in Columbus, Youngstown, and Wilmington might be explored by tracing changes in retail sales volumes. The effectiveness of time-of-day pricing in attaining such objectives as "improving the system's image and promoting good will," on the other hand, are difficult to gauge in any precise sense. Time-of-day pricing's effectiveness with respect to some of these more qualitative types of objectives, in addition to those related to flex-time promotion and environmental improvements, are discussed as part of implementation issues in Chapter Seven.

This chapter, then, extends the findings from the previous one on ridership to trace the financial and performance trends and impacts associated with time-of-day fare programs to date. The initial analysis of ridership and financial impacts is followed by a discussion of efficiency and effectiveness trends. Assessments are made by tracing percent changes in various performance indicators for a period of one year following the introduction of time-of-day pricing. Although it was impossible to statistically remove the influences of other non-fare-related factors due to data limitations, general indications of performance trends associated with time-of-day transit pricing nonetheless emerged.

5.2 Financial Trends and Impacts

Average changes in revenues, fare levels, expenses, and cost recovery rates for a period of roughly one year following the introduction of time-of-day pricing are summarized in Table 5.1.* (See note 1 of the table on how averages were computed.) Averages are presented both for current and discontinued programs, and are further broken down by the type of time-of-day price differentials introduced in each group. It should be pointed out that averages were computed using the percent change in financial performance of each case unweighted by the size of the property. Thus, smaller and larger systems were treated alike. Also, there was tremendous variation in averages among the cases, with standard deviations generally on the order of one to two times as large as the average themselves. The interested reader is directed to Appendix I for more detailed discussions of the financial trends and impacts associated with individual properties' time-of-day fare programs.

Table 5.1 reveals that among thirty systems which have initiated time-of-day pricing since the early seventies, passenger revenues grew, on average, nearly 7% one year after the differential's introduction. A striking difference, however, can be noted between programs involving peak surcharges and differential increases versus those involving discounts. Among systems currently using time-of-day pricing, the fifteen surcharge/differential programs averaged a 23.4% growth in passenger revenues compared to a 14.5% decline for the six discount programs. For discontinued cases, there was a comparable, though less striking, difference between surcharge and discount programs.

The table also shows that two other revenue indicators -- average fares and operating revenues -- followed very comparable trends, perhaps not altogether surprising in that passenger receipts are the major determinants of both. Again, surcharge programs were associated with growing average fares and total income, while discount programs experienced converse relationships.

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* San Francisco's one-month BART experiment with midday discounts and Duluth's off-peak pass program were excluded because of their unrepresentiveness and data limitations.

Table 5.1

Percent Changes in Financial Performance
Following the Introduction of Time-of-Day Pricing,
By Type of Fare Change

	No. of Systems	Average Percent Change[1] in: Passenger Revenue	Operating Revenue	Average Fare	Operating Expense	Coat Recovery[2]
Systems currently with time-of-day pricing	22	+11.9	+15.4	+13.0	+17.5	-0.1
Surcharge or differential increase[3]	15	+23.4	+31.4	+26.0	+19.1	+10.5
Off-peak or midday discount	6	-14.5	-10.0	-17.0	+16.0	-26.5
Off-peak pass	1	-3.0	-3.2	-3.0	+1.6	-1.0
Systems which abandoned time-of-day fares[4]	8	-6.7	-4.8	-7.4	-3.3	-1.9
Surcharge or differential increase[3]	4	+4.6	+9.2	+6.2	+6.8	-1.9
Off-peak or midday discount	4	-18.0	-14.0	-13.6	-10.1	-1.8
All systems combined:	30	+6.7	+10.8	+7.3	+12.2	-0.6

1 In most cases, percent change was computed from data one year after time-of-day pricing was introduced. Because of data limitation, in several cases the percent change was computed using data one year prior and one or less years after the new fare program. All computations are relative to the first introduction of time-of-day pricing in those cases where multiple differentials have been implemented over time. Both calendar and fiscal years are intermixed in the computation of averages because of differences in local accounting procedures. Several extenuating circumstances also influenced changes in some of these financial indicators. In particular, major service cuts were made in Allentown and Chapel Hill while significant service improvements were initiated in Akron and Wilmington during the one-year post-differential period. Moreover, work stoppages took place in Columbus and Sacramento. These factors were removed by extending secular growth trends for service changes (attributing for any differences to be due cuts or improvements) and extrapolating over non-strike months (adjusting for seasonal variations). On the whole, the percent change only provides a rough indication of trends associated with the introduction of time-of-day pricing.

2 Equals operating revenue divided by operating expense, also referred to as the operating ratio. In the case of two discontinued discount programs, data were available only on passenger vis-a-vis operating revenues; thus percent changes in farebox recovery rates were used instead.

3 Refers to both peak and non-midday surcharges, as well as differential rates of peak and off-peak fare increases.

4 San Francisco's BART one-month experience was not included in the computation of averages. For the discontinued off-peak discount program, data on operating revenues were missing for two cases. The averages presented, then, were based on the two other cases for which data were available. See note 2.

Among the eleven systems which identified "increasing revenues" as a major rationale for inaugurating time-of-day pricing (see Table 3.7), the average change in passenger revenues was 18.8% (standard deviation = 19.1%). This is significantly higher than the total average (i.e., for all systems combined) of 6.7%, although less than the average of 23.4% for current surcharge/differential programs.

Table 5.1 also presents average percent changes in operating expenses and cost recovery (operating revenues/operating expenses). Except for discontinued cases of off-peak discounts, operating costs generally rose during the year following time-of-day pricing. In general, expenses increased the most where peak surcharges were introduced, perhaps an impetus behind the programs in the first place. Merging revenue and expense data together, the table shows there was, on average, virtually no change in cost recovery rates of the 30 systems one year following implementation. However, this simple average masks the fact that for systems which retained surcharges, the cost recovery rate grew over 10%, on average, during the first year of their programs. Figure 5.1 reveals the superior financial performance of surcharge programs. Of the 22 systems currently employing time-of-day pricing, 15 (primarily surcharge programs) recovered a higher share of operating expense one year after the program's initiation while the others covered a lower share. The range in the percent change in cost recovery was from -33% in the case of Albuquerque's 1980 20-cent discount to +62% in the case of Orange County's 1981 25-cent peak/10-cent off-peak fare increase. Thus, a significant variation in the cost recovery rates emerged, ostensibly due to a host of other local factors as well, such as more efficient service deployment and cost-cutting programs.

Among the eight systems which identified "recovering higher shares of peak period costs" as a major motivation for introducing time-of-day fares (see Table 3.7), the average change in cost recovery was 15.5% (standard deviation = 23.2%). In that this average is substantially higher than for any other groupings shown in Table 5.1, it appears that time-of-day pricing proved itself to be relatively effective towards achieving this objective. Moreover, among the nine systems which set up specific farebox recovery targets as part of their fare reforms, seven of them were successful in achieving their targets within the first year (see the footnote on the bottom of page 43 in Chapter Three for a listing of these nine properties).

Overall, it can be concluded that the financial positions of transit systems which initiated peak surcharge and differential fare increases markedly improved while those which discounted off-peak fares worsened just as markedly. The tremendous loss in passenger revenues proved to be the deathblow behind the eventual discontinuation of a number of these discount programs.

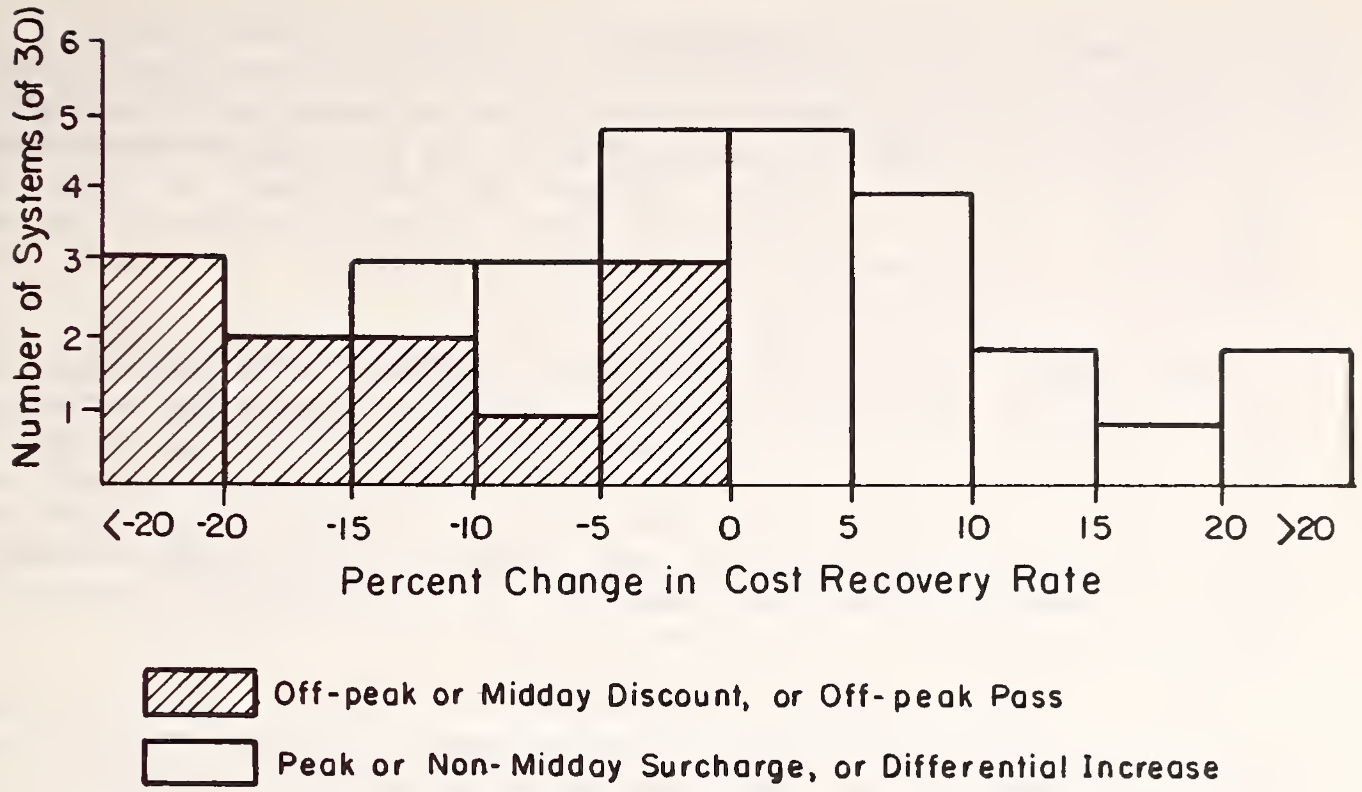

Figure 5.1. Distribution of Percent Change in Cost Recovery Rates, by Type of Time-of-Day Differential

Table 5.2

Percent Changes in Unit Revenues and Unit Costs Following the Introduction of Time-of-Day Pricing, By Type of Fare Change

	No. of Systems	Average Percent Change[1] in: (1) Operating Revenue Per Mile[2]	(2) Operating Expense Per Mile[2]	(1) - (2)	(3) Operating Revenue Per Hour[3]	(4) Operating Expense Per Hour[3]	(3) - (4)
Systems currently with time-of-day pricing	22	+7.0	+9.9	-2.9	+6.8	+9.6	-2.8
Surcharge or differential increase[3]	15	+12.8	+8.2	+4.6	+13.2	+7.6	+5.6
Off-peak or midday discount	6	-7.6	-13.8	-21.4	+9.2	-14.4	-23.6
Off-peak pass	1	N/A	+11.3	N/A	N/A	+11.0	N/A

1 See Note 1 of Table 5.1. Each case is weighted the same, regardless of property size.

2 Expressed on a total vehicle mileage basis

3 Expressed on a total vehicle hour basis

N/A Not Available

5.3 Unit Revenue and Unit Cost Trends

Average percent changes in unit revenues and unit costs are shown in Table 5.2 for three types of time-of-day fare differentials which currently exist.* Revenue and expenses are expressed on both per vehicle-mile and per vehicle-hour bases. Although it would have been preferable to trace these changes for specific periods of the day, data limitations precluded this.

The average change in unit revenues (expressed in both mileage and hourly terms) for 22 systems currently pricing by time-of-day was around 7%.** By comparison, the average change in unit expenses was closer to 10%. This means that, on the whole, systems which have retained peak and off-peak pricing paid more per unit of service than what was returned from the farebox one year after the differential was introduced. In absolute terms, the change in unit expenses was about 3% greater than the change in unit revenues.

Again, however, striking differences are evident in Table 5.2 with regard to surcharge/differential programs versus off-peak discount programs. For the 15 current peak surcharge/differentiated increase programs, unit revenues grew by about 13% whereas unit costs rose in the neighborhood of 8% one year after the programs began. There was considerable variation among properties, however. Denver's 1981 peak surcharge, for instance, witnessed a 44% growth in revenues per vehicle-mile whereas Akron's 1982 non-midday surcharge was followed by a 27% decline in the same measure. Expense per vehicle-hour rose by over 30% following Cincinnati's 1978 differential increase while the same indicator dropped by 6% one year after Sacramento's levying of a 10-cent peak surcharge. In Sacramento's case, however, the decline in unit costs was more attributable to substantial service cuts in the wake of anticipated losses in federal operating assistance than to any other factor. In all, 3 of the 15 surcharge/differential programs witnessed lower unit revenues while 2 experienced lower unit expenses one year after their fare reforms.

The picture appears quite different in the cases of off-peak and midday discount programs. On average, unit revenues declined around 8% to 9% for the six systems, while unit costs rose relatively sharply. Overall, there was more than a 20 percentage point difference in the rate of change between unit revenues and unit costs for these 6 discount fare programs.*** There was less variation among the 6 current discount programs, with all experiencing negative changes in unit revenues and relatively high increases in unit expenses.

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* Data were unavailable for the 10 discontinued time-of-day pricing programs.

** Spartanburg/Anderson's off-peak pass program is not included.

*** Percentage point change refers to the absolute differences between the percentage rates of change in unit revenues and unit costs.

Correlations were generated to gauge how strongly changes in unit costs and revenues were associated with the type of time-of-day fare program and the relative size of the differentials. The following were obtained from 22 cases for which complete data were available:

Pearson Product-Moment Correlations:

	Type of Fare	Percent Differential
Unit Revenue-Cost Change	.72 (.00)	-.06 (.42)

Where: Unit Revenue-Cost Change = Percentage point change between the difference in unit revenues and unit cost (e.g., revenue per vehicle-mile and cost per vehicle-mile). A negative value indicates unit costs increased relatively more than unit revenues.

Type of Fare = Dummy variable coded 0 for off-peak or midday discount programs and 1 for peak surcharges or differential peak/off-peak fare increases.

Percent Differential = Percent differential between peak and off-peak fares

Values in Brackets = Probabilities correlation coefficients equal 0.

The first correlation indicates there was a statistically strong and significant relationship between unit changes in revenues and cost and the type of fare -- with peak surcharge and differential increase programs reaping relatively positive financial gains. On the other hand, there was a weak and statistically insignificant relationship between the relative size of the differential and changes in unit revenues and costs.

In sum, peak surcharge and differential increase programs not only had superior overall financial outcomes to discount arrangements, their balance sheets tended to be healthier in unit terms as well. Notably, unit revenues outpaced unit costs by over five percentage points in Denver, Minneapolis, Orange County, Sacramento, and Tacoma, all places which introduced peak surcharges or peak/off-peak differential increases. On the other hand, unit revenues lagged behind unit expenses by over 5 percentage points in Akron, Allentown, and Columbus, all areas which retained lower midday fares.

On the whole, there appears to be little short-term evidence that time-of-day pricing brings about lower unit costs because of more efficient resource allocation. This undoubtedly stems from the fact that there's very little evidence of significant inter-temporal shifting in ridership. Unfortunately, there is some indication that the additional

passengers drawn to midday and off-peak discount programs are insufficient to make up for the lower fare levels and to improve economic utilization, as suggested by sizable decreases in operating revenues per vehicle-mile.

5.4 Efficiency Trends

Table 5.3 presents changes in several traditional indicators of "operating efficiency" -- i.e., how service inputs are translated into outputs and how economically resources are being used. Although additional indicators would have been desirable, data limitations restricted the analysis to those presented. As with the analyses in the previous sections, each case was weighted equally in computing averages, and the influences of other exogenous factors on these indicators were not statistically controlled.* Thus, Table 5.3 can be viewed as providing only a general gauge of efficiency trends.

The table shows the average peak-to-base ratio of vehicles based on the year time-of-day pricing was introduced as well as the percent change in the indicator one year later. For current time-differentiated fare programs, peak-to-base ratios appear relatively high for systems which introduced discounts vis-a-vis surcharges. For discontinued programs, the exact opposite relationship was found. The reason for this is not altogether apparent, although for all systems combined there does not seem to be any pattern between the ratio of peak to base vehicles and the type of fare differential. During the year time-of-day pricing was introduced, peak-to-base ratios ranged from around 125% or less in Orange County, Salt Lake City, and Albuquerque to over 300% in Seattle, Youngstown, and Baltimore.

The one-year change in the peak-to-base ratio is perhaps most relevant to this research. To the extent that ridership shifting occurs, operators should be able to respond by reducing the peak fleet size and redeploying otherwise idle vehicles to the off-peak period. Changes in peak-to-base ratios might also serve as proxy indicators of how time-of-day pricing has influenced the scale of the overall transit operations, including size of overhead and administrative functions. In general, one might expect the size of the labor force to decline to the extent that peak demands can be redistributed and the peak fleet cut back. Of course, significant changes in the scale of transit and operations involve longer-term structural factors, such as major work rule reforms; still, one would expect some efficiency benefits to be evidenced within a year of time-of-day pricing's implementation, however modest they might be.

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* Several cases were purged from the analysis because of the influences of major changes in service characteristics. To the extent that the affects of exogenous factors, such as changing gasoline prices, influence areas comparably, such factors are effectively controlled for in the computation of average percentage changes.

Table 5.3

Percent Change in Several Efficiency Indicators
Following the Introduction of Time-of-Day Pricing,
By Type of Fare Change

	No. of Systems	Average peak-to-base ratio for the year time-of-day pricing was introduced[1]	Average Percent Change[2] in: Peak-to-Base Ratio of Vehicles	Employees[3]	Vehicle Miles per Employee	Vehicle Hours per Employee
Systems currently with time-of-day pricing	22	209.3	-0.2	+2.6	-2.1	-2.8
Surcharge or differential increase	15	197.2	+0.2	+2.3	-2.1	-2.5
Off-peak or midday discount	6	241.2	-1.4	+3.5	-2.1	-3.6
Off-peak pass	1	200.0	0.0	N/A	N/A	N/A
Systems which abandoned time-of-day fares	6	226.2	N/A	N/A	N/A	N/A
Surcharge or differential increase	4	274.0	N/A	N/A	N/A	N/A
Off-peak or midday discount	2	130.5	N/A	N/A	N/A	N/A
All systems combined:	28	217.0	N/A	N/A	N/A	N/A

1 Two current surcharge programs and two current discount programs are excluded due to unavailable data. Peak-to-base ratio equals number of peak vehicles divided by number of off-peak, or base, vehicles, times 100.

2 See Note 1 of Table 5.1. Each case is weighted the same regardless of property size. Only non-rail systems are analyzed.

3 Computed only for 14 surcharge and 4 discount programs. Other cases were missing.

N/A Not Available

Overall, there was virtually no change in the average peak-to-base ratio of vehicles for the 18 current systems for which data were available. There was only a slight reduction in the ratio for off-peak discount programs -- -1.4%, with the negative sign indicating that, on average, only a marginal improvement in the vehicle deployment throughout the day was measured. For surcharge and differential increase programs, the number of peak vehicles actually increased in relation to off-peak ones, although only slightly. It should be pointed out, however, that there was tremendous variation in these results across properties. Although the average change for surcharge/differential programs was +0.3%, the standard deviation was +9.4%. Notably, several larger systems which introduced surcharges did experience significant reductions in peak-to-base ratios -- Orange County (-9.6%); Minneapolis (-8.3%); Sacramento (-6.8%); and Washington Metrobus (-6.6%). On the other hand, Denver's 17% increase was due more to its liberal expansion of peak-hour express services than to any other factor. Keeping in mind that the averages shown in Table 5.3, by themselves, present somewhat of a distorted picture, it's apparent that some individual properties enjoyed significant distributional benefits in terms of vehicle usage from time-of-day pricing.

An attempt to isolate in on the average percent changes in peak-to-base ratios of those systems which sought to shift ridership as a priority objective (see Table 3.7) failed to yield anything interesting. One might expect these systems to have lower peak-to-base ratios due to the emphasis on ridership shifting; however the average change for the 11 systems for which data were available was only -.06%, not significantly different than the average change for all systems combined of -0.2%.

Surprisingly, there was a modestly positive correlation of .39 (probability = .11) between the percent change in peak-to-base ratio and the relative size of the differential for 22 systems for which data were available. This is somewhat counterintuitive in that systems with relatively large differentials would be expected to experience the greatest ridership shifts and therefore the greatest redeployment of vehicles from the peak to the base periods. Evidently, factors other than the fare programs were responsible for whatever changes occurred in the reallocation of vehicles throughout the day.

Table 5.3 also suggests that other efficiency indicators were largely unaffected by time-of-day pricing. The size of the systems' overall work force* grew, on average, by over 2%, again with tremendous variation among properties. Six of the 18 current systems for which data were available experienced a decline in work force size following time-of-day pricing, with largest being Minneapolis's 2.5% drop. The tremendous variation again suggest that other factors were probably more influential in effecting properties' labor force size than time-of-day pricing itself.

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* Refers to total employment, including operations, maintenance, and administrative staffs

Finally, Table 5.3 cites average changes in two commonly-used indices of labor productivity -- vehicle miles per employee and vehicle hours per employee.* Both indices dropped, on average, by over 2% following the implementation of time-of-day pricing, regardless of the version adopted. There were, again, sizable differences in labor productivity trends, however. In Akron and Orange County, for instance, vehicle miles per employee rose by over 10%, whereas the same indicator declined at a comparable rate in Tacoma and Wilmington. Again, other factors were likely at play in addition to the fare differential.

Besides the aggregate figures shown in Table 5.3, several noteworthy individual cases of efficiency improvements were also recorded during this research. Following Rochester's 15-cent discounting of midday fares in 1975, ten peak-hour runs were eliminated and the overall peak fleet of vehicles was reduced from 204 to 190 (see Appendix I.29). Local officials attributed these reductions wholely to the discount program. Sacramento reduced its workforce and hired additional part-time drivers following its 1981 initiation of a 10-cent peak surcharge, although local officials attributed this as much to a conscious effort to trim deficits as to anything else (see Appendix I.14).

In Columbus, seat occupancy** rose from 40% to 63% during midday hours, but dropped slightly to around 59% during peak periods following the 1981 lowering of midday fares to 35 cents (see Appendix I.8). This load shifting resulted in a transfer of 10 driver assignments from the peak to noon-time hours. On the negative side, however, was the overcrowding of some midday runs in Columbus, perhaps due more to the provision of free downtown services from 9:30 a.m. to 3:00 p.m. than to the discount program. According to local officials, overcrowding forced some users who previously paid full fares to begin driving their automobiles instead. In addition, the incidence of scheduled buses running more than three minutes late increased by 22% in Columbus between 1981 and 1982. These oversubscription problems are similar to those experienced in Denver and Trenton during their 1978 free fare programs (Doxsey and Spears, 1981). Besides Columbus, sizable increases in off-peak load factors were also reported in Erie and Denver following their initiation of time-of-day pricing.

5.5. Effectiveness

Effectiveness, as used in the transit industry, generally reflects how well agency objectives are being met, usually in terms of service utilization measures (e.g., total ridership, passengers/mile). In general, the intensity of service usage declined following the inauguration of time-of-day pricing. Among 15 current systems which initiated peak surcharges or differential increases, revenue passengers/mile declined,

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* Vehicle-hours include deadheading, sign-on and sign-off times, as well as in-service hours; thus, no distinction is made between revenue and non-revenue portions of service.

** Equals percent of total seats occupied.

on average, 7.3% (standard deviation = 11.7%). Again, considerable variation was found. In Denver and Columbus, the two areas initiating the largest differential, revenue passengers/mile increased by over 10% within one year of their respective time-of-day fare changes. By contrast, the same indicator declined by over 10% in Akron, Orange County, Sacramento, and Salt Lake City. For discounted programs, passenger/mile increased 2.9% (standard deviation = 8.7%). Again, this variability suggests that other unaccounted for explanatory factors were at play.

Evidence on the achievements of other objectives set for time-of-day pricing is largely anecdotal. There's some signs, for instance, that Columbus's midday discount and free downtown fare program helped to stimulate CBD retail activities. Daily ridership to downtown Columbus rose by one-third one month after the incentive fare program was initiated (see Appendix I.8). Downtown merchants immediately heralded the new fare program as a tremendous traffic builder and boon to the central city. Further evidence is the nearly $2 million in dedicated sales tax receipts above that expected during the first year of Columbus's incentive program -- translating into $400 million in regional retail sales above that estimated. Local officials attributed the boom in sales volumes to the multiplier effect of stimulating downtown business activities through the promotional fares.* Columbus officials proudly note that sales tax revenues rose 13.7% during the first month of the incentive fare program, while for the same period during the previous year they decreased 9.5%.

One would expect, however, any sales tax gains, such as in Columbus's case, to be related to larger regional economics forces. That is, in the absence of a growing economy, any increases in downtown business sales would be purely redistributive -- i.e., taking away retail transactions from non-CBD areas.** Nevertheless, the fact remains that Columbus is in a financially more viable position than several years earlier (because of the tremendous gains in dedicated sales taxes), and the contention that the midday discount program has been responsible for this may very well hold some truth.

Other objectives of maintaining low off-peak fares, particularly in Cincinnati and Columbus, were to increase public awareness of transit services and promote the local systems' images. Time-of-day pricing's "effectiveness" in these regards can only be speculated. Interviews with local transit officials in both places revealed that most believe lower off-peak fares have played important promotional roles, however no more than assorted service improvements offered during the same period. A survey of over 1,000 Columbus area residents, for instance, found that the incentive fare program enjoyed high visibility and support -- about three-quarters of the residents were aware of the midday discount arrangement and felt that the region's transit services were reasonably

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* Over 57% of downtown shoppers in Columbus reach their destination by bus.

** This could not be substantiated because sales tax revenues in Columbus are only maintained on a county level.

priced. On the whole, one would expect any discount program to impart some public good will, however the acid test is whether people start filling up off-peak buses and fareboxes.

5.6 Summary and Conclusion

Table 5.4 summarizes the direction of changes in key performance indicators for 14 larger properties which still differentiate fares by time-of-day and for which complete data were available.* The table suggests that financial and performance trends have varied on a property by property basis following the initiation of time-of-day pricing. A general pattern does emerge, however, that systems which introduced surcharges fared far better in financial terms, while those which offered off-peak discounts tended to enjoy more efficiency and service utilization benefits. Specifically, surcharge programs tended to return higher shares of costs through the farebox and witnessed unit revenues rising faster than unit costs. Discount programs were consistently worse off in both respects.

In general, peak-to-base ratios of vehicles remained fairly constant one year following the adoption of differential fares. There only seemed to be a modest redeployment of vehicles from the peak to the midday period in Erie, Columbus, Minneapolis, Orange County, Sacramento, and Seattle. Areas discounting off-peak fares generally ended up redeploying equipment the most. Also, the size of most properties' labor force continued to increase following the differentiation of peak and off-peak fares, though the tremendous variability in this statistic suggests that other factors were probably more influential in this regard. The greatest gains in labor productivity, as suggested by vehicle miles per employee, also tended to be in areas offering promotional fares.

Overall, systems seemed less effective in capturing riders per mile of service following time-of-day pricing, although a sizable variation in this index was noted. Properties introducing the largest differentials, notably Columbus and Denver, seemed to experience more intensive service utilization following their programs' inauguration. Finally, there was some anecdotal evidence that time-of-day fare promotions, particularly Columbus's combined 35-cent midday discount and free core zone, helped to stimulate retail activities and thereby contribute to the objective of strengthening downtown commerce.

It is difficult to reach any conclusions regarding time-of-day pricing's performance impacts because of the sizable variability in trends across properties. On the whole, however, agencies' financial solvency, operating efficiency, and effectiveness at attracting additional rides (per unit of service provided) seemed to be only modestly affected. Only in cases where fares were differentiated by adding on a peak surcharge did cost recovery rates generally increase. The

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* For all indicators, except peak-to-base vehicles, a positive sign denotes a desirable change. For the peak-to-base vehicle indicator, a negative sign is hoped for.

efficiency and effectiveness advantages of off-peak discounts, by comparison, were relatively minor.

Table 5.4

Summary of Trends in Financial
and Operating Performance for Fourteen Properties
Currently Using Time-of-Day Pricing

	Cost Recovery	Unit Revenues-Unit Costs	Peak-to-Base Vehicles	Vehicle Miles per Employee	Passengers per Mile
Surcharge Programs:*					
Akron	-	-	+	+	+
Cincinnati	+	-	+	+	+
Denver	+	+	+	-	+
Minneapolis	+	+	-	+	-
Orange County	+	+	-	+	-
Sacramento	+	+	-	-	-
Salt Lake City	-	+	+	-	-
Seattle	-	-	-	-	-
Tacoma	+	+	+	-	-
Wilmington	+	-	+	-	-
Discount Programs:**					
Allentown	-	-	+	+	-
Columbus	-	-	-	+	+
Erie	-	-	-	+	+
Louisville	-	-	+	-	-

* Includes peak surcharges, non-midday surcharges, and differential increase programs.

** Includes off-peak and midday discount programs.

Chapter Six

Equity and Time-of-Day Pricing

6.1 Equity in Transit Policy

Although time-of-day fares have been introduced in recent years primarily as an efficiency strategy, equity has been a motivating factor as well. In fact, ten properties cited equity as the primary or secondary reason for differentiating peak and off-peak fares. Perceptions of equity varied, however. Some agencies, like the Southwest Ohio Regional Transit Authority (Cincinnati) and the Baltimore Mass Transit Administration, justified higher peak fares partly on capacity-to-pay principles* -- rush hour commuters are generally considered to be more affluent and are therefore in a better position to pay higher fares. Others, like the Kansas City Area Transit Authority and the Duke Power Transit (Spartanburg and Anderson), designed their off-peak fare programs largely to benefit all transit dependent groups, including elderly, handicapped, and school-age passengers. Still others, like Pierce Transit (Tacoma) and the Delaware Administration for Regional Transit (Wilmington), used beneficiary principles of equity to justify time-of-day pricing, arguing that higher levels of service available during the peak warranted higher fares. Thus, although transit agencies implementing time-of-day pricing perceive equity in different ways, there is nonetheless the belief that differentiated fares redress some of the maldistributive effects of uniform pricing and more fairly assign costs to users.

Different versions of time-of-day pricing could be expected to have varying impacts on transit-dependent users. In the case where off-peak fares have been discontinued, one would expect those with limited financial resources to either ride more often, or make the same number of trips, however shifting more of them to the off-peak. Where fare increases have been limited to peak hours, transit-dependents would likely benefit less. Some lower-income users may be unable to shift because of a fixed work schedule. Theoretically, one would expect higher peak fares to occasion more equitable conditions because cross-subsidies would be reduced. However, since off-peak users would still be paying the same fares, few changes in travel behavior would likely result.

In this chapter, the possible equity impacts of time-of-day pricing are explored by examining the composition of ridership before and after time-of-day pricing was adopted. The analysis focuses solely on Allentown (Lehigh and Northhampton Transportation Authority -- LANTA), Columbus (Central Ohio Transit Authority -- COTA), Louisville (Transit Authority of River City -- TARC), Minneapolis (Metropolitan Transit Commission -- MTC), Orange County (Orange County Transit District -- OCTD),

* Under the capacity-to-pay principle, prices for public services are set according to the relative income level of users (Musgrave and Musgrave, 1980).

and Salt Lake City (Utah Transit Authority). Although ridership profile data obtained from these six properties were not ideal, they were nevertheless the best available among all systems which have introduced time-of-day pricing.

6.2 Study Methodology

Five groups which represent the population of transit dependent riders in the U.S. are the elderly, the young, females, minorities, and the poor. Although not all senior citizens, minorities, and women are reliant on public transit, these groups, on average, earn less than middle-aged, white, and male Americans and consequently make up a relatively high share of transit patronage.

To fully evaluate the equity implications of time-of-day pricing one would need to examine income redistributive effects -- i.e., whether the ratio of passenger fares to trip costs changed for transit-dependent groups. Allocating costs to specific user groups can be exceedingly difficult, however. Moreover, fairly precise before and after ridership data is required to trace changes in user profiles. Unfortunately, most of the 32 U.S. urban transit systems which have implemented time-of-day pricing had insufficient data for exploring income transfer and other distributional consequences of their fare programs. However, for the six systems which did conduct on-board ridership surveys from periods before and after the differential was introduced, it was possible to trace changes in ridership composition. This was considered to be a "second best" approach, in that those who benefitted the most from the differential would be expected to increase their rates of transit trip-making relatively more. Thus, if the fare program had positive distributional consequences, the relative incidence of usage should increase among those considered to be more transit-dependent.

Ideally, one would hope for fairly standardized before-and-after ridership surveys; preferrably, identical surveys would be administered at equivalent points in times prior to and after peak/off-peak pricing was adopted. In that this research was conducted after time-of-day fare programs were first introduced, the design and administration of surveys could not be controlled. Thus, the following analysis was limited in terms of scope (only 6 of the 32 systems could be studied), and interpretation (rarely were ridership data consistent across these six transit systems or over time within any one system). In most cases, socio-economic variables drawn from the later surveys were not totally comparable with variables from earlier ones. This limited the extent and rigor of the analysis, and the conclusions drawn therefrom.

Table 6.1 summarizes each agency's fare structures both before and after time-of-day pricing was introduced. MTC (Minneapolis) and UTA (Salt Lake City) implemented a peak surcharge, while COTA (Columbus) and TARC (Louisville) lowered their midday fares. OCTD (Orange County) raised their peak fares higher than off-peak ones (i.e., differential increases) while LANTA (Allentown) lowered fares for all off-peak hours. COTA has the largest differential (35 cents) while LANTA and UTA have the smallest (10 cents).

Survey contents differed widely among the six systems. LANTA, OCTD, TARC, and UTA conducted their surveys both before and after the fare change as part of an on-going system monitoring effort. Only COTA administered its survey specifically to determine the effects of the new midday discount. Thus, most surveys were not coordinated with the timing of the fare change. Consequently, the length of time between surveys varied from less than a year (COTA) to more than five years (LANTA). In addition, administration of the surveys was generally asymmetric with respect to the date of implementation -- i.e., in some cases, the before surveys preceded the fare change by several years whereas after surveys were carried out shortly thereafter.

Table 6.1

Time-of-Day Program Characteristics

Type of Program[1]	Allentown (LANTA)	Columbus (COTA)	Louisville (TARC)	Minneapolis (MTC)	Orange County (OCTD)	Salt Lake City (UTA)
Implementation Date	10/72	6/81	4/73	6/82	6/81	7/81
Date:Before[2] Survey	12/74	5/81	1/73	N/A	10/79	4/79
Date:After[2] Survey	3/80	6/81	10/74	1/83	11/82	8/81
Time Between Surveys	5 yr., 3 mo.	4 wks.	1 yr., 10 mo.	N/A	3 yr., 1 mo.	2 yr., 5 mo.
Adult Fare: Before Survey	$.35/ .25	.60	.50	.60	.50	.15
Adult Fare: After Survey[3]	$.40/ .30	$.60/ .25	.50/ .25	.75/ .60	.75/ .60	.50/ .40
Absolute Differential	$.10	.35	.25	.15	.15	.10
Percent Differential	40%:[4] 33%	140%	100%	25%	25%	25%

[1]See Table 3.2 for definitions of fare type.

[2]Peak fare/Off-peak fares are presented.

[3]Dates before surveys and after surveys were collected.

[4]Change in LANTA's fare differential between 1974 and 1980.

N/A -- Not Applicable. MTC did not conduct before ridership surveys, however the agency did carry out an after survey where relevant data.

Another problem was implicit survey bias. Persons making short, off-peak trips, for example, are often underrepresented because they are usually not on-board long enough to complete surveys. Young, undereducated, or non-English speaking riders may have had difficulty understanding questionnaires, while those who are disabled may be unable to complete them. The following analysis proceeds "as if" the survey samples are unbiased even though this is rarely the case.*

The next section summarizes before-and-after ridership data from COTA, LANTA, OCTD, TARC, and UTA. In that MTC came closest to obtaining information relating directly to the effects of time-of-day pricing on ridership composition, its survey results are discussed in more detail separately in section 6.4.

6.3 Ridership Composition Changes

Table 6.2 summarizes changes in ridership profiles following the implementation of time-of-day pricing in Allentown, Columbus, Louisville, Orange County, and Salt Lake City. Variables analyzed are AGE, SEX, RACE, and TRANSIT DEPENDENCY. AGE was grouped into ordinal headings (i.e., youth, middle-low income) representing roughly comparable categories in an effort to adjust for discrepancies between definitions of the before and after surveys. Definitions of SEX and RACE were consistent among agencies after non-white (e.g. black, Hispanic, Asian) were aggregated under the heading "minority". TRANSIT DEPENDENCY presents a definitional problem since identification of captive and choice riders was based on divergent criteria.** Though information is missing for all agencies except COTA and TARC, the following trends were nonetheless revealed:

AGE: Generally, little change was seen in the distribution of ages except in the case of COTA, where there was a noticeable increase in the representation of elderly riders. It should be pointed out that COTA's 25 cent midday discount provided senior citizens a five cents savings over previous fares, while for the other five systems senior citizens were already receiving off-peak discounts below the off-peak adult fare level. In view of COTA's sizable discounting of off-peak fares,

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* The responses themselves may be biased in other ways. Poor persons traditionally have been reticent in disclosing income information; hence the percentage of low-income persons in the sample may be artificially low. Student-age riders may also have difficulty with questions regarding income, since they are not generally self-supporting wage-earners, and may substitute estimates of their parents' earnings. Though likely less problematic than questions of income, questions of ethnicity may be sensitive ones for some riders, or the racial categories themselves may be confusing, leading to no responses.

** For some systems, transit dependency was estimated by asking respondents how many cars were owned (zero used as an approximation of transit captivity); others queried riders as to whether a car was available for the transit trip made.

Table 6.2

Summary Ridership Statistics for Five Agencies

	Columbus (COTA)			Allentown (LANTA)			Orange County (OCTD)			Louisville (TARC)			Salt Lake City (TARC)		
AGE	Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change	Before	After	Change
Youth	15.9	12.0	-3.9	3.3	4.0	0.7	10.0	7.9	-2.1	33.4	33.6	0.2	28.7	26.0	-2.7
Mid Low	31.8	24.0	-7.8	22.6	29.6	7.0	57.6	60.9	3.4	22.3	24.2	1.9	45.6	40.0	-5.6
Mid Hi	33.7	36.0	2.3	47.5	41.7	-5.7	22.7	21.5	-1.2	27.5	26.2	-1.3	16.0	22.0	6.0
Elderly	18.6	28.0	9.4	26.6	24.7	-1.9	9.7	9.7	0.0	16.8	16.1	-0.7	9.7	13.0	3.3
	100.0	100.0		100.0	100.0		100.0	100.0		100.0	100.1		100.0	100.0	
SEX															
Male	21.7	34.9	13.2	26.4	32.7	6.3	42.0	43.7	1.7	30.5	29.8	-0.7	50.6	48.0	-2.6
Female	78.3	65.1	-13.2	73.6	67.3	-6.3	58.0	56.3	-1.7	69.5	70.2	0.7	49.4	52.0	2.6
	100.0	100.0		100.0	100.0		100.0	100.0		100.0	100.0		100.0	100.0	
RACE															
Minority	29.2	43.6	14.4	N/A	N/A	---	N/A	36.5	---	35.8	36.6	+0.8	16.4	22.0	+5.6
White	70.8	56.4	-14.4	N/A	N/A	---	N/A	63.5	---	64.2	63.4	-0.8	83.6	78.0	-5.6
	100.0	100.0						100.0		100.0	100.0		100.0	100.0	
TRANSIT DEPENDENT[3]															
Captive	73.0	34.7	-38.3	65.1	42.2	-22.9	70.9	73.9	30.0	87.5	61.7	-25.8	N/A	N/A	---
Choice	27.0	65.3	38.3	34.9	57.8	22.9	29.1	26.1	-3.0	12.5	38.3	25.8	N/A	N/A	---
	100.0	100.0		100.0	100.0		100.0	100.0		100.0	100.0				

NOTES: [1] COTA represents midday ridership distributions only; all others present total system distribution.

[2] Before -- percent of total respondents from before survey
After -- percent of total respondents from after survey
Change -- percent (after)/percent (before)

[3] Transit Dependency refers to whether users either owned automobile or had one available. Captive users are autoless whereas choice ones have a car option.

N/A -- Not Available

however, this finding is consistent with the contention that elderly passengers are fairly price-sensitive. Under UTA's peak surcharge, there also seemed to be a slight shift to older passengers. The other three properties appeared to experience relatively modest changes in the age distribution of riders. In fact, young and elderly ridership tended to be the most stable. Again, this probably reflects the fact that youth and elderly discounts were available prior to the adoption of time-of-day pricing, consequently dampening impacts that may have been felt in the absence of such discounts.

SEX: COTA again demonstrated the largest shift among males and females after the implementation of differential fares. The relative decline in female passengers, however, seems counter-intuitive in that women on the whole would be expected to be the primary beneficiaries of lower off-peak fares. In that COTA's discount program was targetted at downtown transit trips, this redistribution suggests that males benefitted more from the program by virtue of the fact that they comprise a large share of the central city professional work force. Also, since sex is a less reliable proxy for ability-to-pay than other measures, this apparent contradiction is perhaps less surprising. This might also explain the relative stability of gender distribution for the other properties. Finally, the possibility of survey bias cannot be ruled out.

RACE: Racial composition data were available only from COTA, TARC, and UTA. Again, major shifts were evident only in COTA's data, with minorities increasing their share of midday ridership after the fare change. If indeed minorities have lower incomes on average than whites, COTA's significant discounting of midday fares would be expected to attract more blacks, Hispanics, and other non-white groups. It is noteworthy that UTA also witnessed a relative increase in minority usage after implementing a surcharge program, although the charge is within the tolerance of sampling error due to a small absolute number of minority passengers. In all probability, the differentials in Allentown and Orange County were too small to bring about changes in riding habits, at least in terms of race. Since only distributions of total ridership are presented, however, shifts between time periods may be masked.

TRANSIT DEPENDENCY: COTA, LANTA, and TARC demonstrated rather dramatic shifts to choice riders after implementation of their fare changes. In the case of LANTA and TARC major service improvements instituted between the before and after surveys probably served to attract a significant proportion of riders who may have used their cars previously. The higher cost of owning a vehicle might have placed more persons in the captive category by the late seventies also. In the case of COTA, the relatively short period between surveys (only about four weeks) might have captured a "novelty" period wherein all persons were experimenting with the new discount. Longer term changes in travel behavior could prove to be modest, however. The shift in Orange County to more captive riders is more in line with expectations, but is fairly modest, again perhaps because of the relatively small differential.

INCOME: The income of riders was the most problematic variable because of the effect of inflation on relative wealth over time. Only for COTA was this not an issue, since Columbus' short time between

surveys avoided inflationary effects. If the distribution of ridership by income were examined in actual dollar terms, the share of higher income riders would invariably increase over time simply due to inflation. However, removing the influences of inflation by expressing income in constant dollars results in non-compatible "before" and "after" income groups.

Table 6.3 presents the proportion of ridership for inflation-adjusted income groups. Income data of the before periods were adjusted to dollar values constant with the after-period categories. Although difficult to interpret, general inspection of the table suggests that income distributions appear to have remained fairly stable for OCTD, and there appears to have been some shift to the higher income brackets in the case of UTA. Fortunately, inflation adjustments were not as radical in the case of TARC, and unnecessary for COTA, facilitating the interpretations. There seems to have been a small shift towards higher income groups represented in the riding population of both properties. With regards to TARC, this was likely due to the substantial improvements in service levels which accompanied the transition to public ownership. In the COTA case, higher income representation, slight though it may be, probably reflects the "novelty" affect described above as well as the dominance of downtown professionals as disproportionate benefactors of the midday discount/free fare program.

Overall, what do these findings suggest? Except for some of the trends evidenced among COTA's off-peak ridership, the distributional consequences of time-of-day pricing appear fairly modest. This suggests that substantial differentials and discounts (as in COTA's case) are necessary before noticeable changes in not only the number but also the mix of ridership will result. COTA's somewhat unexpected shifts towards male, more affluent and higher income users likely reflects some of the idiosyncrasies of its fare change. It is important to remember that in the cases of the other four properties, survey results measured only overall changes in ridership, not changes in trip distributions for specific time of the day. On the whole, arguments made by advocates of time-of-day pricing that appreciable equity benefits will result from such fare systems do not seem to be borne out by the data from these five properties. It is apparent that the relatively small surcharges in most cases was not perceived by any one group of users to be significant enough to warrant changes in travel behavior. Even among the poorer riders, the $.10-.15 differentials were probably not considered important enough to modify either when or whether a transit trip would be made.

6.4 Minneapolis MTC: Evidence on Changing Trip Behavior Among Ridership Groups

Minneapolis's MTC conducted a survey following its introduction of time-of-day pricing which perhaps provides the most valuable insights into shifting patterns among all of the systems studied. A profile of MTC ridership was obtained from a systemwide survey administered in January, 1983, approximately six months after the agency's peak surcharge was introduced. (A similar before on-board survey was not conducted.) The survey queried respondents as to whether their trips had

Table 6.3

Changes in Ridership Composition by Income:
Columbus, Louisville, Orange County and Salt Lake City
(expressed in constant $)*

Transit Property	Annual Family Income ($) Before Fare Change	%	After Fare Change	%
Columbus (COTA)	(Constant 1981 $)	%	(Constant 1981 $)	%
	under 10,000	59.3	under 10,000	55.7
	10 - 20,000	31.1	10 - 20,000	32.9
	20 - 30,000	5.9	20 - 30,000	7.1
	30,000 +	3.7	30,000 +	4.3
		100.0		100.0
Louisville (TARC)	(Constant 1974 $)	%	(Constant 1974 $)	%
	under 5,550	48.8	under 5,000	46.6
	5,550-16,650	42.6	5,000-15,000	45.8
	16,650-27,750	6.5	15,000-25,000	10.5
	27,750 +	2.1	25,000 +	3.1
		100.0		100.0
Orange County (OCTD)	(Constant 1982 $)	%	(Constant 1982 $)	%
	under 6,650	17.3	under 5,000	16.8
	6,650-19,950	38.0	5,000-15,000	34.5
	19,950-33,250	23.4	15,000-25,000	18.6
	33,250 +	21.3	25,000	30.1
		100.0		100.0
Salt Lake City (UTA)	(Constant 1981 $)	%	(Constant 1981 $)	%
	under $6,650	31.5	under 5,000	24.0
	6,650-18,800	55.1	5,000-15,000	39.0
	18,800 +	13.4	15,000 +	37.0
		100.0		100.0

*Constant dollar incomes were computed relative to the year when the after survey was conducted. This resulted in different price indices for each property, however, differences between before and after figures were reduced as a result.

decreased in number, remained the same, or shifted to off-peak hours since the fare change. Responses were disaggregated by various socio-demographic characteristics and cross-tabulated with the perceived impacts of time-of-day fares on trip-making behavior. Again, one must be cautious in assigning changes in trip making solely to differential pricing, since the crosstabulations do not control for other potential intervening factors. In particular, MTC's survey was conducted during January, often a cold-weather month which might have influenced travel behavior. Moreover, there is no assurance that what riders say on a survey versus what they actually do are the same. The possibility that

riders biased their responses in favor of "hoped for" results cannot be overlooked.

Table 6.4 presents survey responses. With respect to age, the youngest and elderly riders seemed to have been affected most by MTC's 15 cent surcharge. Of riders under 18 years of age (3.1% of the sample), 21.3% said they were riding less, while another 31.2% said they shifted their trips to the off-peak. The elderly also seemed to be fairly sensitive to higher peak fares, particularly given that the 10 cent senior citizen off-peak-only discount became all the more attractive.

Captive users -- i.e., those who did not own a car -- made up 48.8% of those sampled and demonstrated the greatest tendency to shift their travel to the off-peak.* Among income categories, only those earning less than $10,000 annually seemed to be significantly affected by MTC's peak surcharge. Over 30% of these riders indicated that they shifted their trips to the off-peak, twice the percentage of any other income group.

In sum, MTC's lower income, school-aged, and captive users seemed to shift their time period of travel significantly following the add-on of a 25% peak surcharge. Whether these findings reflect factors unique to Minneapolis can only be speculated. The findings are generally in keeping with expectations, however, and lend some creditability to the argument that time-of-day differentials can have positive equity repercussions.

6.5 Summary and Conclusions

This chapter has sought to address the equity implications of time-of-day pricing using the best information available. Unfortunately, what could be obtained was fairly limited. There is little evidence that time-of-day pricing has significantly affected the composition of ridership for those systems studied. Whether traditionally transportation-disadvantaged groups benefitted the most from fare differentials (and thus are riding more) could not be ascertained from available data. Only Columbus's substantial midday discount appeared to influence ridership mixes to any noticeable extent, while Minneapolis's survey data suggests that captive and lower income users have the highest propensity to shift. In both cases, however, possible intervening and contaminating factors could not be controlled. Table 6.5 summarizes the findings based on a qualitative assessment of the six case sites.

It is evident that more controlled experimental settings will probably be required to fully probe the equity impacts of time-of-day pricing. Before and after studies can be revealing, though they should be conducted within a year of the fare change (to remove inflationary

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* To estimate car accessibility, the MTC survey queried riders as to why they took the bus. Respondents who indicated that they didn't own a car were considered to be transit captives.

Table 6.4

Changes in Travel Behavior by Ridership Group for Minneapolis's MTC

	Following Fare Differential, % of Users who:		
	Rode Less	Shifted Period	Total[1]
AGE			
Youth	21.3	31.2	52.2
Middle Low	12.5	19.6	32.1
Middle High	9.5	11.2	20.7
High	5.9	30.5	36.4
SEX			
Male	13.4	18.2	31.6
Female	10.0	17.8	27.8
INCOME			
Low	13.0	31.7	44.7
Middle Low	10.7	15.0	25.7
Middle High	9.4	10.5	19.9
High	11.9	9.9	21.8
RACE			
Minority	N/A	N/A	---
White	N/A	N/A	---
TRANSIT DEPENDENCY			
Captive	11.9	63.9	75.8
Choice	10.6	17.4	28.0

[1] Total percent of MTC users who either ride less or shifted time period of trip, or both.

N/A -- Not Available

influences) and be symmetrical around the initiation date (i.e., six months before and six months after). Information not only on ridership composition, but also on the costs of different types of services, would enable an even more rigorous assessment of redistributive impacts to be made. A panel study, wherein the same group of riders would be sampled before and after the fare change, would probably yield the most

insightful equity insights.

Table 6.5

Qualitative Assessment of the Distributional Consequences of Time-of-Day Pricing on Transit-Dependent Groups, for Six Case Study Sites

	Overall Change in Ridership Composition*			
Ridership Group	Fairly Significant	Moderate	Modest or None	No Information
Low Income	Columbus Minneapolis	Louisville Salt Lake City	Orange County	Allentown
Young	Minneapolis		Allentown Columbus Orange County Louisville Salt Lake City	
Elderly	Minneapolis	Columbus	Allentown Orange County Louisville Salt Lake City	
Racial Minority		Columbus	Louisville Salt Lake City	Allentown Orange County Minneapolis

* Changes for Columbus are with respect to the proportion of midday ridership. Changes for Allentown, Louisville, Orange County, and Salt Lake City are with respect to the proportion of total ridership; and Changes for Minneapolis measure reported shifts from peak to off-peak periods for decreases in total ridership.

Chapter Seven

Implementation Issues

7.1 Introduction

Time-of-day transit pricing raises major questions in the minds of some regarding implementation -- in particular, how can it be made to work, both logistically and politically? As discussed in the second chapter, a host of factors stand as potential barriers to the actual implementation of peak/off-peak pricing, including difficulties in collecting the differentials and the tendency of users and drivers to resist more complex fare structures. Pressures to balance off the many competing objectives associated with time-of-day pricing has given rise to inventive and carefully designed implementation programs.

This chapter discusses key implementation issues surrounding time-of-day transit pricing as well as the various strategies designed to cope with them. Among the issues are: fare payment and collection approaches; attitudes of various special interests; marketing and promotional strategies; and private sector responses. An effort is made to point out exemplary approaches toward implementation and to isolate in on those factors which appear most important towards facilitating the introduction of major pricing reforms. Chapter Eight follows up on this theme by carrying out more in-depth case studies of the politics behind time-of-day pricing in Cincinnati, Columbus, and Washington. Since implementation issues are so crucial, it is felt that time-of-day fare programs which are operating relatively smoothly deserve particular attention in the transit community.

7.2 Fare Payment and Collection

Many consider the logistics of collecting differentiated fares to be the major roadblock to their implementation. American transit properties converted en masse to flat fares during the sixties and seventies primarily because collection was simpler and usually dispute-free. Unless careful attention is paid to the details of collecting fare differentials, confrontations between drivers and users will invariably increase and the very survival of the fare reforms will be at stake.

7.2.1 Coping with the Boundary Problem

Perhaps the major collection issue pertains to the boundary problem -- i.e., determining exactly when and where the change in fare rate will occur. If the morning break point is 9:30 a.m., for all practical purposes it really costs no more to carry someone at 9:28 as opposed 9:32. Such a rigid boundary poses inequities and invites confrontations. A passenger paying a 75 cents peak fare would understandably resent someone boarding several blocks away paying only half as much. Moreover, two riders on the same bus run could pay different fares with the rider making the shortest trip paying the most. Also, buses running behind schedule could result in some customers paying higher fares than they otherwise would. Clearly, the possibilities for fare disputes increase manyfold under time-of-day pricing.

Two different approaches to collecting fares differentiated by time-of-day have emerged:

1. Time-Based Collection -- Fare rates change exactly according to the clock, regardless of where along a run the bus might be or the direction of the trip.

2. Run-Based Collection -- Fare rates change only when a new run begins, often according to direction of the trip and with reference to the area's central business district. This arrangement means that any coach making a trip which arrives at its morning destination or leaves its afternoon origin during the peak period is considered a peak trip. Anyone boarding during that time pays a higher fare.

The time-based approach is perhaps simplest of the two to implement, but has all of the pitfalls discussed above. Mainly, disputes invariably occur when rigid time borders are adhered to. Its only real advantage is that a consistent policy on fare rates is applied throughout the system, with prices changing on all routes at the same time. Thus, it's simpler and more comprehensible.

By comparison, the major advantages of run-based collection are that disputes are virtually eliminated and price changes more closely reflect true cost variations. User-driver confrontations are reduced because everyone boarding a bus from the beginning to the end of a regularly scheduled run pays the same fare, as opposed to the fare changing, say, midway along a route. Moreover, peak riders can be clearly identified and late coaches cause few problems. Run-based collection captures cost variations more closely because it's usually only when driver tours are completed at the end of the morning or evening peak that expenses begin to perceptibly fall, rather than in the middle of a run. That is, only on outbound runs after the morning peak or inbound runs after the evening peak do true "off-peak" conditions begin. In short, defining peak and off-peak periods according to runs and directions from the central city more closely reflects cost differences than the precise hands of the clock. Perhaps the major drawback of run-based collection is that the designated peak and off-peak varies from route to route, adding some complexities and arbitrariness (due to scheduling differences among routes).

Among the 22 U.S. systems currently differentiating fares by time-of-day, 15 have adopted time-based collection while the remaining 7 have opted for run-based collection. Fares are differentiated according to run in Binghamton, Columbus, Erie, Orange County, Sacramento, Seattle, and Wichita. Among the ten systems which have discontinued time-of-day pricing, only Kansas City and Rochester used run-based collection. Palms Springs also restricted fare changes to major collection/discharge points along a route, although rate changes could occur midway along a run regardless of direction.

For almost all run-based collection cases, the direction of a run from the downtown area serves as the major determinant of which fare rate applies. Thus, only when buses leave the major downtown terminus after the morning rush period or at the beginning of the evening rush period is a higher fare collected. In addition, pulse scheduling is

used in Binghamton, Columbus, Orange County, and Wichita to facilitate run-based collection. Under this arrangement, buses are scheduled so that they converge on the downtown area at roughly the same time, thus facilitating transfers while also allowing the time-of-day fare change to occur at the same approximate time for most routes. In all areas using run-based pricing, individual bus schedules are either shaded or printed in bold-face lettering to distinguish where along a route peak versus off-peak fares will apply. Schedule shading provides a visible and understandable means of identifying exactly when and where the fare break will occur. Exhibit 7.1 displays examples of shading and bold-faced printing used to distinguish fares in Columbus and Orange County.

Time-based collection is usually based on the precise hours of the clock (i.e., Greenwich Mean Time), although there's a number of variations on this. In Akron, Chapel Hill, Cincinnati, Denver, and Minneapolis, peak fares are not collected exactly according to the clock, but rather at a significant collection/discharge point along the route where buses are scheduled to be within roughly five or ten minutes of the designated peak period. In these five areas, the fare breaks are also clearly displayed on individual bus schedules, although unlike in the case of run-based collection, fares can change in the middle of a run. In other areas, the exact time of day is literally interpretted in distinguishing between fares. Some areas have clocks aboard buses (set every morning according to the division garage's clock), while others (e.g., Akron and Washington) rely on drivers' watches. In Cincinnati, radio dispatchers inform all drivers when the peak period is in effect.

In areas where time-of-day pricing has been implemented on rail systems, time-based collection has been instituted with few difficulties. In both Washington and San Francisco, magnetic ticket machines (used to collect distance fares) and entrance gates have been timed to automatically adjust the required fare to account for peak and off-peak differentials.* In the case of Boston, when fares dropped to only a dime during midday hours, station attendants manually adjusted coin turnstyles. Boston officials noted that patrons often huddled around the fare gates just before the attendants adjusted the turnstyles at 10 a.m. to take advantage of the 10 cents fare (see Appendix I.25).

It should be pointed out that in virtually every setting studied, drivers were encouraged to exercise discretion in collecting fare differentials. In particular, drivers were almost always told to charge off-peak fares if a tardy bus caused some passengers to miss out on a lower fare, and always to give the benefit of the doubt to the customer. Some areas explicitly stated such policies in drivers' manuals. In the final analysis, drivers' judgments were generally relied upon to enforce the fare differential.

7.2.2 Other Aspects of Fare Collection

In addition to shaded schedules, some agencies place visible flip signs aboard buses or decals on fareboxes to officially designate when

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* Washington's Metrorail provides off-peak discounts by eliminating distance surcharges during non-peak periods. See Appendix I.19.

18 KENNY ROAD

MON-FRI SOUTH

LEAVE MACKENZIE & REED	LEAVE DREW & REED	LEAVE OLENTANGY & ACKERMAN	LEAVE CANNON & HAYES DRIVE	LEAVE BROAD & HIGH	DUE MOUND & HIGH
6:50	6:54	7:15	7:25	7:42	7:50
7:50	7:54	8:15	8:25	8:42	8:50
8:50	8:54	9:15	9:25	9:42	9:50
9:50	9:54	10:15	10:25	10:42	10:50
10:50	10:54	11:15	11:25	11:42	11:50
11:50	11:54	12:10	12:25	12:42	12:50
12:50	12:54	1:15	1:25	1:42	1:50
1:50	1:54	2:15	2:25	2:42	2:50
2:50	2:54	3:15	3:25	3:42	3:50
3:50	3:54	4:15	4:25	4:42	4:50
4:50	4:54	5:15	5:25	5:42	5:50
5:50	5:54	6:15	6:25	6:42	6:50
6:50	6:54	7:15	7:25	7:42	7:50
7:50	7:54	8:15	8:25	8:42	8:50

FREE FOR ALL—

Fare is free within the innerbelt 9:30 AM - 3 PM Monday thru Friday.

NOTE:

Special Midday 25 cent fare, 50 cent Midday Transfer and Midday Monthly Pass apply to shaded areas.

ROUTE 1 MON THRU FRI SOUTHBOUND

LONG BEACH TO SAN CLEMENTE

Circle Drive-In	Cal State Long Beach	Coast Hwy & [illegible]	Coast Hwy & Warner	Coast Hwy & Lake	Hamilton & Magnolia	32nd & Balboa	Fashion Island	Coast Hwy & Marguerite	Laguna Beach Bus Station	Coast Hwy & Crown Valley Pkwy	Coast Hwy & Del Obispo	K-Mart Plaza
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		535A	541A	550A	556A	607A	621A	627A	642A	656A	701A	708A
612A	616A	620	637	647	654	705	721	720	742	750	805	812
642	648	658	707	717	724	735	751	750	812	820	835	842
722	720	730	747	707	804	815	831	830	852	908	915	922
752	700	800	817	827	834	845	901	909	922	938	945	952
820	833	843	851	901	908	919	935	943	956	1012	1019	1026
901	908	918	926	936	943	954	1010	1018	1031	1047	1054	1101
936	943	953	1001	1011	1018	1029	1045	1053	1106	1122	1129	1136
1011	1018	1028	1036	1046	1053	1104	1120	1128	1141	1157	1204P	1211P
1046	1053	1103	1111	1121	1128	1139	1155	1203P	1216P	1232P	1239	1246
1121	1128	1138	1146	1156	1203P	1214P	1230P	1238	1251	107	114	121
1156	1203P	1213P	1221P	1231P	1238	1249	105	113	126	142	149	156
1231P	1238	1248	1256	106	113	124	140	148	201	217	224	231
101	109	119	127	137	145	158	215	225	238	256	303	310
136	144	154	202	212	220	233	250	300	313	331	338	345
211	219	229	237	247	255	300	325	335	346	406	413	420
246	254	304	312	322	330	343	400	410	423	441	448	455
321	329	330	347	357	405	416	435	445	450	616	523	530
350	404	414	422	432	440	453	510	520	533	551	558	605
431	439	446	457	507	515	528	548	558	608	626	633	640
513	522	533	540	548	557	607	620	628	639	654	700	707
540	557	608	615	624	632	642	655	703	714	729	735	742
629	636	644	652	700	707	716	730	737	748	802	808	815
705	712	720	728	736	743	752	806	813	824	838	844	851
805	812	820	828	836	843	852	906	913	924	930	944	951

BOLD FACE TIMES INDICATE PEAK HOURS

Peak hours: Monday thru Friday, 6-9AM & 3-6PM

Exhibit 7.1. Examples of Schedule Shading and Bold-Face Printing to Highlight Run-Based Collection for Columbus's COTA and Orange County's OCTD

peak versus off-peak hours are in effect. Conspicuous signs are used in Cincinnati, Columbus, Seattle, and Tacoma. Denver officials noted that some of their drivers place their own home-made signs aboard buses with the message "The fare is now 70 cents" in an attempt to reduce fare confusion.

It's noteworthy that off-peak fare levels were set partly to facilitate the collection process in several places. Columbus adopted a 25 cents midday fare because officials felt that a single coin would expedite the boarding process. Denver's 35 cents off-peak fare and 70 cents peak fare were arrived at because local officials wanted to encourage token usage. In that Denver's tokens, purchased in multiples at a 20% discount, are valued at 35 cents each, an off-peak ride costs one token while a peak one requires two.

Besides the special efforts made to deal with the boundary problem, all of the case study areas were found to employ fairly conventional fare collection practices. No automated collection equipment was used in any of the areas. Drivers were given ultimate responsibilities for collecting the differentials, although some non-enforcement was readily acknowledged by officials in Columbus, Wilmington, and several other areas. No cases of self-service fare collection were found, although Wilmington has billed its combined zonal and time-of-day fare structure as an honor program since drivers play only a modest enforcement role.

No records were available to trace changes in rates of fare evasion from before and after the inauguration of time-of-day pricing in any of the areas. From interviews, managers and drivers in Columbus and Washington indicated that the incidences of cheating have risen in both places, though factors other than the fare differential were considered to be just as responsible (see Appendices I.8 and I.19). In the case of Duluth's off-peak pass program, fare abuses were felt to have increased because drivers had a difficult time distinguishing between peak and off-peak passes.

7.3 Reactions to Time-of-Day Pricing

The general reactions of various groups to time-of-day pricing are important barometers of whether or not such fare reforms will find political acceptance. This section charts the responses of board members, drivers, staff, and users to the transit time-of-day fare programs introduced to date.

7.3.1 Board Reactions

In general, policymakers have been either indifferent or mildly supportive of time-of-day pricing. From interviews, transit managers for about three-quarters of the systems indicated that their boards supported the time-of-day pricing proposals from the beginning and, except for cases where the programs have been discontinued, the boards continue to support the programs today. The strongest backing for peak/off-peak pricing came from board members in Akron, Allentown, Burlington, Cincinnati, Columbus, Denver, Erie, Louisville, Orange County, and Tacoma. In all of these cases, agency staffers aggressively promoted the idea of time-of-day pricing through special workshops and other efforts designed to explain the rationales behind peak/off-peak differentials. In Orange

County, for instance, several subcommittee meetings of the board were devoted to discussing the economics of public transportation, with staff explaining why peak period costs tend to more than during other hours of the day. Strong board support also stemmed from the business orientations of policymakers in some areas. In particular, management in Akron, Cincinnati, Columbus, and Wilmington pointed out that time-of-day pricing was favorably received since decisionmakers in these areas considered it to be the most efficient and business-like alternative.

Board members were perhaps the most apprehensive in Binghamton, Albuquerque, and Duluth because of concerns over the fare systems' complexities as well as over possibly losing too much farebox revenue. In Minneapolis, there was board opposition to the time-of-day fare program from the very beginning, however the differential has been retained due to current state law which restricts the raising of off-peak fares. And, of course, in the ten areas where time-of-day pricing was subsequently discontinued, the majority of each agency's board members eventually withdrew their support in favor of more simplified pricing approaches.

7.3.2 Driver Reactions

In most areas, drivers have been fairly ambivalent towards time of day pricing. Interviews with agency managers and driver representatives revealed that drivers in one-half of the areas have expressed few opinions on time-of-day pricing, with drivers in the other sixteen areas being about evenly split in favor and against the fare structure. The strongest support was voiced by drivers and their representatives in Washington, Denver, Louisville, Orange County, Sacramento, and Tacoma. Drivers have perhaps been most apprehensive in Binghamton, Columbus, and Albuquerque, and have outwardly opposed the differentials in Burlington, Minneapolis, Baltimore, and Kansas City. In Minneapolis, driver opposition is based on a concern over deteriorated service levels. There, drivers argue that the extra coinage and time spent explaining the fare system to customers have resulted in longer boarding times and therefore poorer schedule maintenance. In the other three areas, drivers have complained about fare disputes at the time-borders and the added complexities of their assignments. Baltimore and Kansas City responded to these protests by discontinuing the differentials. In Kansas City, a formal grievance filed by driver representatives was the major impetus behind the program's demise.

Other driver complaints have been aired as well. From interviews, Columbus's rank-and-file representatives indicated that the collection of the 25 cents midday fares from exiting passengers who travel out of the downtown free zone has resulted in numerous confrontations. Consequently, many of Columbus's drivers have turned their heads when it comes to enforcing off-peak payment (see Appendix I.8). Wichita's drivers protested the 1983 exactment of a 15 cents peak surcharge on the grounds that it compromised the unions contract by potentially pricing too many users off of the system. Binghamton's drivers openly complained that higher peak fares penalized the system's bread and butter users and petitioned for a return to flat fares. Baltimore's drivers chided management over the policy on strict adherence to time-based collection. Moreover, some of Washington's bus drivers have complained that the 5 cents off-peak surcharge is so token as to be a nuisance.

Despite these isolated complaints, the general reaction of drivers to time-of-day pricing has been mostly one of indifference. Drivers in Cincinnati, Wilmington, and Washington, in fact, have had far greater problems in enforcing zonal fares as opposed to the time-of-day differential. Moreover, drivers in Denver and Washington actually lauded time-of-day pricing when it was initially introduced as a simplification of earlier finely graduated fare practices. In most cases, drivers have received training on all aspects of the fare structures and have been indoctrinated into the idea of peak/off-peak pricing through formal training and education programs.

7.3.3 Staff and Management Reactions

Professional staffs and managers were generally the initiators of time-of-day fares in each area, and therefore have tended to be the most vocal proponents. The idea to initiate time-of-day pricing did not appear to originate with any particular professional position, but rather among general managers, planners, marketing directors, and financial managers alike. From interviews with staffs of several agencies, however, budget directors seemed initially uncomfortable with off-peak discount programs because of concerns over excessive revenue losses. Managers of operations for several agencies also expressed initial apprehension over the effects of collecting fare differentials on service quality and driver morale. With time, both financial and operations managers have perhaps grudgingly accepted the fare differentials in most of these areas.

In most areas which have retained time-of-day fare differentials, staff and management support generally remains fairly solid. In areas which abandoned their peak/off-peak programs, staff support began to erode as the various revenue, administrative, and implementation problems discussed in Chapter Three began to surface. Needless to say, continued staff backing is vital towards the maintenance of time-of-day fare programs in areas which have retained them.

7.3.4 User Reactions

Transit patrons in most areas have generally accepted time-of-day pricing with very few qualms. Interviews with agency officials revealed there were isolated user complaints when the differentials were initially implemented in 22 of the 32 areas. Officials surmise that the fare reforms were generally well-received because of effective marketing and user education programs. In several areas, notably Cincinnati and Washington, users openly embraced peak/off-peak pricing because it was perceived to be simpler than the previous zonal fares. In Akron and Louisville, users initially applauded the programs since differentials were introduced by lowering both peak and off-peak fares (i.e., differential reductions). Moreover, officials in Wilmington indicated that time-of-day pricing came at a time of massive system changes (e.g., reduced headways, newly painted and air conditioned buses, and newly installed shelters) and consequently benefitted from a spirit of innovation. Officials believed that major service improvements lent creditability to the fare reforms.

Managers in Akron, Allentown, Cincinnati, Denver, Louisville, Washington, and Youngstown stressed during interviews that time-of-day

pricing is today accepted by areawide citizens because it has become so institutionalized in these communities. Moreover, officials in five areas which have both time-of-day and graduated fares (of more than two zones) noted that most users have had few problems understanding the fare systems because they make the same trip and pay the same fare regularly.* Some observers emphasized that arguments against differentiated pricing based on over-complexity have been blown out of proportion since the vast majority of users end up paying only one fare routinely. It's probably the case that complex fare structures are more intimidating to visitors and occasional users than regular passengers.

The user complaints which have been aired against time-of-day pricing are varied, though perhaps somewhat predictable. Major complaints are summarized below:

- Complaints Among Peak Users: Managers indicated that there were large numbers of complaints voiced by peak hour users after surcharges were instituted in Minneapolis, Burlington, and Chico. Rush hour patrons were disgruntled over having to pay higher fares and felt surcharges were unfair given the often poorer quality of peak period services. In addition, some dissatisfaction was expressed over discount programs by peak hour patrons in Columbus and Rochester on the grounds that working class citizens would reap few benefits.

- Complaints Over Off-Peak Fares: Complaints were lodged against midday discounts and free downtown services in Rochester because some perceived the programs benefitting principally white collar professional employees. This was a major factor behind the elimination of Rochester's incentive fare program.

- Complaints By Specific User Groups: Senior citizens and handicapped patrons were the most outspoken critics of time-of-day pricing in Binghamton and Burlington principally because discounts were eliminated during peak periods. These same groups protested Sacramento's fare change because surcharges became required for all discounted passes used during peak periods. In general, senior citizens and handicapped groups have been the most vocal opponents against peak surcharges at public hearings, not so much because of the differentials themselves but because of concerns over the impacts of general fare hikes on fixed-income groups.

- Complaints Over Fare Collection: The strongest user protests against time-based fare collection were found in Baltimore and Erie. High incidences of passenger-driver disputes at time borders were initially recorded, though drivers were advised to use their discretion in enforcing fare payment.

- Complaints Over Complexities: Patrons outwardly complained about the complexity of the fare systems in Kansas City and Minneapolis. Both places combined time-of-day pricing with zonal fares, a combination which perhaps proved to be overly complicated. Moreover, Kansas City and Orange County officials cited relatively high incidences of over-

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* The five areas are: Cincinnati, Minneapolis, Seattle, Washington, and Wilmington.

payment during off-peak periods due to user confusion. Orange County drivers continue to report substantial numbers of non-English speaking patrons, primarily southeast Asians and Latinos, who pay the full fare during off-peak hours because they simply don't understand the differential and are fearful of being accused of cheating the system. Also, many users found the pass programs in Minneapolis and Washington to be complicated by the addition of various peak period surcharge requirements.

• Complaints Over Peak/Off-Peak Hour Designations: There was somewhat of a public outcry over the designation of peak and off-peak hours in a number of areas. In particular, citizens in Denver and Washington complained bitterly that the long time periods designated for the peak discouraged anyone from shifting when they traveled to take advantage of lower fares (see Appendices I.9 and I.19). In Washington's case, a seven hour peak was designated, while Denver defined its peak to be six hours. Commuters were the most critical of the time designations in both places. In contrast, complaints over the peak designation in Seattle were aired mainly by shoppers who considered 3:00 p.m. to be too early in the afternoon to charge commute-hour rates. There were fewer complaints over the designation of off-peak discount hours, with the exception of Boston's 10:00 a.m. to 1:00 p.m. dime-time which was felt by many to be far too narrow. Finally, the peak period designation became an issue in Orange County because it was widened from five hours to six hours just two weeks after the fare program was introduced. Officials felt too much revenue was being lost with the five hour peak, so they quickly redefined it. This caused some disgruntlement among passengers who found themselves missing out on a cheaper fare. As a result, over 100 formal complaints were filed regarding Orange County's fare system during its first three months, compared to a usual three-month complaint rate of about 20 (see Appendix I.13).

• Other User Complaints: Other user complaints were aired which were more incidental to time-of-day pricing itself. In Minneapolis, for instance, peak surcharges were ill-received by the public because they represented the fourth consecutive fare increase in as many years. Also, several residents of the Washington area protested at public hearings over the flat off-peak rapid rail fare because they felt longer distance trip-makers were failing to pay their fair share (see Appendix I.19). Protestors argued that lower distance rates rather than flat off-peak fares represented a more equitable way of accounting for the lower costs of providing off-peak services.

7.3.5 Summing Up Reactions

In general, the reactions of many groups to the initiation of time-of-day pricing were about what could be expected. There appeared to be some initial skepticism among policymakers and drivers when proposals were discussed, though apprehensions generally waned after the programs were in place. In a few areas, policymakers were concerned over losing too much revenue as well as the possibility of users becoming intimidated by the fare system. Drivers in several areas were mostly concerned over the likely increase in disputes with customers, though in most cases they were indifferent to the pricing policy. No incidences of driver representatives using the time-of-day fare issue as a bargaining chip to argue for higher wages were found. Among agency staff,

there was generally widespread support for time-of-day pricing, though in several cases finance officers expressed some apprehensions. And passengers generally reacted with ambivalence towards the fare reforms, ostensibly because of effective marketing and user educational programs. Some complaints over the perceived inequities and complexities of the fare structures were aired, however user protests generally subsided with time. Perhaps the most vocal protests were directed at the designation of peak period hours, which riders in some places found to be too wide. Overall, however, time-of-day pricing was found to be generally well-received in most places.

7.4 Other Attitudes Toward Time-of-Day Pricing

In addition to the views and opinions expressed through interviews with officials in each of the 32 areas which have employed time-of-day pricing, a national survey of professionals in the transit field was conducted. This survey sought to augment current insights into the attitudes of transit officials towards time-of-day fares. Overall, the survey revealed considerable support for peak/off-peak fare differentials.* The survey gathered responses from officials of 69 systems, including 30 systems which currently have or which have had experience with time-of-day pricing. Along with the other 39 systems in the sample, all 44 U.S. systems with more than 250 revenue vehicles are represented.** The 176 individual respondents included 57 general managers or assistant general managers and 119 other professional staff members across all functional areas (e.g., finance, administration, planning, operations and marketing) and of all ranks (junior analysts to department heads).

As Table 7.1 illustrates, an overwhelming proportion of transit industry professionals believe that varying fares by time of day would be a good or very good idea:

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* The survey is described more fully in Appendix III.

** U.S. Department of Transportation, 1982.

Table 7.1

Would Varying Fares by Time of Day
Trip is Made Be a Good or a Bad Idea?

Operators Which Have:	Percent of Respondents Who Thought Time-of-Day Pricing Was a: Good/Very Good Idea	Bad/Very Bad Idea	Total
Experience with Time-of-Day Pricing (30 systems)	94.3	5.7	100% (N=53)
No Experience with Time-of-Day Pricing (39 systems)	84.7	15.3	100% (N=105)
Total	87.9	12.1	100% (N=158)

In those agencies which have not implemented time-of-day fares, 85% of respondents still thought such fares would be a good idea. Furthermore, 25% of respondents in these agencies reported that time-of-day fares are now under consideration, and another 40% indicated that such fares had been considered by their agencies, but rejected. Only 16% of respondents from agencies without time-of-day pricing experience indicated that such fares have not been considered at all for their systems. Thus, time-of-day pricing appears to be widely supported and discussed in the industry, even though the actual number of agencies currently differentiating peak and off-peak period fares is small. Still, the high level of interest augurs well for the future of time-of-day pricing in the U.S. and indicates that the issue may come up again in agencies which previously rejected the idea.

The survey also queried respondents about their preferences for the boundaries of the morning and evening peak periods. The 115 respondents who answered the question offered a bewildering array of alternatives, forty-five separate combinations of morning and evening beginning and ending times in all. The two most frequently mentioned combinations were 6 to 9 a.m./3 to 6 p.m. (24 respondents, or 20.9%) and 7 to 9 a.m./4 to 6 p.m. (21 respondents, or 18.3%). It is noteworthy that these preferred boundaries match those which are most frequently defined among the properties which currently elect peak surcharges (see Table 3.6). The principal combinations are diagrammed below:

Table 7.2

Preferred Boundaries for Peak Periods

```
              ---------A.M. Peak--------     --------P.M. Peak--------
Number of       6.....7.....8.....9.....10     3.....4.....5.....6.....7
Respondents
-----------

   (2)          -------------                        -------------
  (24)          -------------------            -------------------
   (3)          -------------------              -------------------
   (6)          -------------------                  -------------
   (3)          -------------------                  ----------------
   (5)          -------------------                  -------------------
   (2)          -------------------            -------------------------
   (2)          ----------------------         ---------------------
   (2)          ----------------------            ----------------------
   (2)             -------------                  -------------
   (4)             -------------                     -------------
   (2)             ---------------                   ----------------
   (2)                ----------                     ----------
  (21)                ------------                   -------------
   (2)                ----------------            ----------
```

The 15 combinations shown in Table 7.2 were proposed by 82 respondents. Of the other 33 who answered the question, 8 provided incomplete answers and the other 25 each proposed a unique and slightly different combination of times. The overall averages are summarized in Table 7.3.

Table 7.3

Averages of Preferred A.M. and P.M.
Peak Hour Designations

	Mean Preferred Start Time*	Mean Preferred End Time*	Average Length of Peak
A.M. Peak	6:21	9:02	2 hrs. 41 min.
P.M. Peak	3:32	6:11	2 hrs. 39 min.
Total	--	--	5 hrs. 20 min.

* Standard deviations: A.M. Peak Start - 35 min., A.M. Peak End - 24 min.; P.M. Peak Start - 32 min., P.M. Peak End - 25 min.

These averages should be viewed with caution, given the wide variability in time responses. The peak periods ranged from one to six hours in length, starting as early as 5 a.m. and ending as late as 11 a.m. for the morning period, and bridging 2 p.m. to 7 p.m. in the afternoon. The average preferred duration of the peak -- 5 hrs. and 20 mins. for both morning and evening periods -- is slightly less than the actual average of 5 hrs. and 43 minutes of the 16 systems shown in Table 3.6 which have actually introduced peak surcharges or differential increases.** Clearly, the definition of "peak periods" is not only a highly localized affair determined by specific travel patterns, but a highly personalized perception as well. The effects of narrowly versus broadly defined peak period are discussed elsewhere in this report.

7.5 Marketing and Promotional Efforts

The general receptiveness of riders to time-of-day pricing can be largely attributed to effective marketing and educational programs which were launched during the pre-fare-change period in most areas. Marketing programs generally had both information dissemination and promotional components. In all but a few areas, some combination of advertising, brochures, notices, and news releases were used to inform the public of the impending fare change and to publicize the benefits of riding during lower-priced off-peak periods. The most commonly-used marketing medium was usually information posters and brochures placed aboard buses, often supplemented by newspaper advertisements and radio announcements. In several areas, notably Burlington and Columbus, the transit agency's general manager played an active role in promoting the fare program through talks given at public meetings and television interviews. In Erie, a promotional film was even prepared to acquaint

** Duluth was not included in this average since its one-half hour designated peak period for excluding discounted pass usage was unrepresentative of the other cases. It might also be pointed out that the inclusion of responses from most of those properties which actually price by time-of-day in Table 7.3 partly accounts for the similarities.

the riding public with the time-of-day fare concept. And in Wilmington, four major public hearings were held throughout the area to explain the new fare structure and convince the public of its importance to the long-term fiscal health of the transit agency.

Although most marketing efforts were well-designed and ambitious in scope, several stand out as particularly impressive. When Columbus initiated its 25 cents midday discount program in 1981, an extensive $40,000 promotional effort and media blitz was undertaken through television, radio, and newspaper advertisements. A massive mailing and brochure campaign was also launched to inform the public of the impending fare change. Moreover, merchants gave away a total of 267,000 store prizes and free ride coupons during the opening week of the fare program as a good will gesture. A weekend retreat at a posh downtown hotel was even donated as the grand prize during the opening promotional week (see Appendix I.8). Comparable marketing emphases were found in Cincinnati, Boston, Washington, and Rochester. In general, the most aggressive marketing campaigns were mounted in support of off-peak discount programs vis-a-vis those involving peak period surcharges.

From interviews with local transit officials, it was disclosed that very little, if any, formal marketing was carried out in Albuquerque, Binghamton, Louisville, Tacoma, and Youngstown for sundry reasons. Tacoma's information and promotional campaign, for instance, was relatively low-keyed because officials felt the public realized a fare increase was long overdue and therefore expected little resistance. Youngstown did not aggressively market its midday discount program when it was reintroduced in 1982 since the public was already familiar with the concept of differential pricing. Louisvilles fare differential had been fairly institutionalized by the time of public takeover, therefore little marketing was considered necessary.

It's noteworthy that as a conscientious marketing strategy, a number of the transit properties advertised the program as an off-peak discount and bargain fare rather than a peak/off-peak fare differential or surcharge. This choice of semantics was used even by systems which truly introduced a surcharge. Management often opted for this marketing ploy to cast the fare system in a positive public relations light and in an attempt not to disenfranchise rush hour commuters. As part of this effort, marketing focussed almost exclusively on advertising the monetary benefits of travelling during off-peak hours, with hardly any mention of the higher peak hour fares. Jingles like "Incentive Fares", "Bargain Fares", and "Fair Fares" were used in Cincinnati, Columbus, Denver, Erie, Seattle, Washington, and Wilmington to emphasize the advantages of off-peak usage. Perhaps it is no small coincidence that the fare programs have generally been well-received in each of these areas, evidenced, in part, by the continued pricing of services by time-of-day in each place.

The marketing of time-of-day fares as discounts rather than surcharges suggests an appreciation of consumer psychology among transit agency officials. Undoubtedly this emphasis had something to do with the general public receptivity to time-of-day pricing in many areas. Comparable marketing efforts have been used in other industries with considerable success. Only recently, for example, gasoline service stations have been advertising their new pricing schemes as cash discount

arrangements, rather than intimating that surcharges will be collected for credit card usage. Although this marketing ploy might appear somewhat trivial on the surface, its potential effectiveness at building a base of public support for new pricing arrangements should not be overlooked.

In addition to marketing the fare programs as discounts, several areas also consciously introduced a small differential initially, in recognition of a possible backlash of resistance from peak hour users. Officials in Cincinnati, Orange County, and Washington indicated that a small differential was initially agreed upon as the most politically palatable strategy, even though there was every intention to gradually widen the differential over time. As noted in Chapter Three, however, this has actually been done only in Burlington, Cincinnati, and Denver.

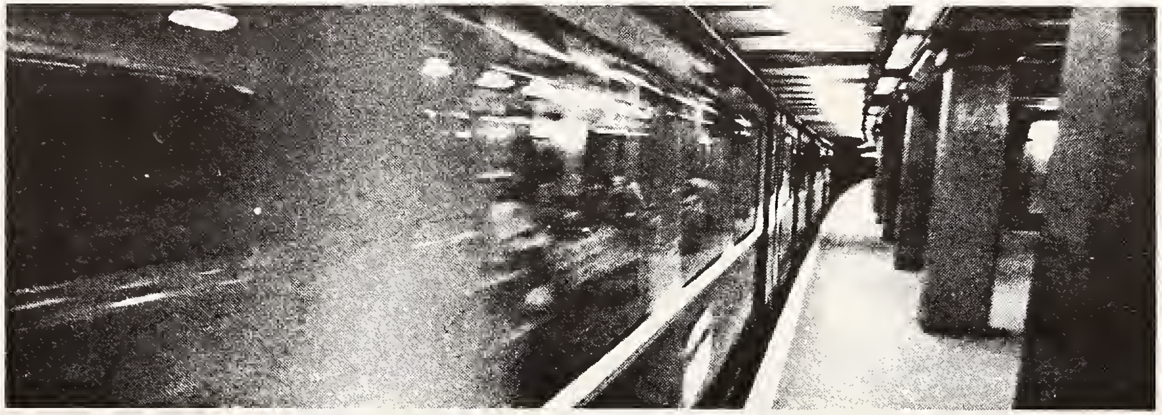
While the scope of marketing prior to the initiation of time-of-day fares was fairly impressive, there have been few instances where such promotional efforts have been on-going. Rather, in almost all cases, the marketing blitz was a one-time effort. In most areas, on-going marketing of the fare program consists solely of providing users fare schedules which emphasize the potential savings from riding during the off-peak as well as an occasional announcement to that effect. In Washington, for example, brochures are sometimes circulated which inform both visitors and residents of the many places which can be reached in the nation's capital for only 70 cents by bus and 75 cents by rail during off-peak hours. In spite of curtailments in marketing, there's some evidence that public awareness of the fare differentials has remained high. In Columbus, for instance, a random opinion poll of 1,000 area residents conducted one year after the differential was introduced revealed that 72% of the public were aware of the midday discount. And in Boston, station surveys found 80% of all riders were aware of the dime-time discount at the beginning of the program, and within one year the share share had risen to 98%.

Although user information was widely disseminated when time-of-day fares were first implemented, advertisements regarding the discontinuation of off-peak discounts and fare differentials were comparatively subdued. Usually a short statement was issued, along with brochures and revised fare schedules, to inform the riding public of the change in policy. In most cases, only an abbreviated reason was given for the discontinuation. The contrast in approaches used to initially announce the discount program and to inform the public of its suspension is exemplified in Exhibit 7.2 for Boston's 1973-1975 "Dime Time" program.

7.6 Private Sector Responses

Most of the private sector activities in promoting time-of-day pricing involved providing free store prizes and issuing free tokens to store customers during the first week or so of the fare programs. In Burlington, Cincinnati, and Columbus, for instance, free return ride tokens were provided by downtown business merchants to promote the new fare programs. Also, Erie's business community helped to finance free in-bound off-peak services. Moreover, downtown interests were instrumental in building political support for lower off-peak fares, in addition to downtown free zones, in Columbus, Denver, Seattle, and Youngstown. In the case of Youngstown, merchants underwrote the costs of

What this country needs is a good 10¢ subway fare.



Boston, here's Dime time.

We're experimenting with a new 10 cent fare policy. Here's what it is and how it works. As of Monday, April 2, you can take advantage of what we're calling "Dime time".

Dime time will be a period from 10 AM to 1 PM, Monday through Friday, where you can get on the T and ride for just a dime. Dime time will be in effect for the next three months on certain lines. If it works out, we'll extend the ten cent fare policy to the entire system.

To our riders:

Effective August 1, Dime Time is suspended.

Regular fares will now be in effect all day.

Over two years ago, we began our experimental Dime Time program. Through it, we hoped to increase (T) ridership, and to spread out the ridership to include "off-peak" hours, thus relieving rush hour congestion.

Regrettably, the Dime Time experiment has not proven successful in either area, and so, from an economic standpoint, we are forced to suspend it.

In the future, however, we do intend to continue exploring different fare reduction plans and other innovative transit ideas. Please stay with us – an improved (T) system is on the way!

Your MBTA

Exhibit 7.2. Informing the Public about Boston's Dime Time: Program Initiation and Suspension Announcements

providing off-peak discounts during the seventies, but eventually withdrew their support due to the local transit system's escalating deficits. Other private sector initiatives involved the printing of bus schedules which promote off-peak usage (Burlington), employer purchases of off-peak passes (Allentown), and privately-financed advertising of bargain fares for off-peak shop trips (Columbus and Erie).

Surprisingly few instances of concerted efforts to implement flex-time work arrangements in conjunction with the time-of-day fare programs were found. Given the relatively wide time bands designated for peak hours by most systems, the establishment of flex-time work programs would seem to be imperative if significant time shifts in commuting were to occur. A fair number of flex-time work arrangements, however, were initiated at roughly the same time peak/off-peak fare differentials were introduced in Cincinnati, Columbus, Denver, Duluth, Sacramento, Wilmington, and Washington. Although the fare programs themselves did not directly spawn the creation of these work arrangements, they nonetheless were probably a reinforcing factor. In Cincinnati, for example, flex-time programs at several major companies in the area were initiated, in part, at the urging of several corporate executives who served on the local transit board, according to some observers. In Columbus, Denver, Sacramento, and Washington, flex-time work programs were established for civil servants at the state or federal levels, generally as part of an energy conservation strategy. From interviews with local officials, there was some indication that the abilities of employees to take advantage of lower-priced off-peak fares entered into the decision to initiate or expand flex-time programs. Despite these efforts, there's no evidence that the degree of shifting between time periods has been greater in these communities than any others.

The most extensive effort to promote flex-time through the fare program was in Duluth as part of an UMTA Service and Management Demonstration Program (see Appendix I.26). There, off-peak passes, priced at $3 less than the regular pass, were made available to companies which had at least 30% of their employees beginning work other than between 7:45 and 8:00 a.m. The lack of employer interest in the program, evidenced by the creation of only one significant flex-time program during the one year demonstration, led to the abandonment of the off-peak discount.

Although not a private sector action, the most significant scheduling response to time-of-day fares was by Allentown's school district. There, school hours were modified to allow students to take advantage of lower off-peak fares. The shifting of school trips out of the morning peak was found to have a noticeable effect on Allentown's peak load conditions.

7.7 Other Implementation Factors

Several other factors, unique to individual areas, have either facilitated or hampered the implementation of time-of-day pricing. Programs in Denver, Wilmington, and several other places benefitted from the various service improvements which were simultaneously introduced. Reductions in headways, newer buses, and more extensive routings helped to cast the fare differentials as part of a larger program of progressive change in several of the areas. Some of the unique impediments to

time-of-day pricing pertained to fare collection. In Columbus, the collection of midday discounts from riders who disembarked after travelling outside of the free downtown zone has proven to be a major source of confrontation, to the point where some drivers fail to enforce the midday fare requirement. In Minneapolis, management cites the two-part payment scheme for longer distance afternoon trips as a major inconvenience and source of confusion. There, outbound afternoon commuters pay the peak surcharge upon boarding and zonal increment upon exiting. Despite rider complaints, Minneapolis transit officials feel powerless to collect both peak and zonal surcharges any other way. Perhaps the most complicated time-of-day fare arrangement has evolved in Washington, where the entire fare structure reflects years of political bargaining among multiple jurisdictional interests (see Chapter Eight and Appendix I.19). There, over 100 different transit fare rates are possible, depending on when and where one travels, who the rider is, whether a pass is being used, whether a transfer is being made, and whether the trip is on bus or rail.

7.8 Conclusion

Approaches toward implementation are important factors behind time-of-day fare programs. How fares are collected, user reactions, and marketing strategies seem to have a strong bearing on whether time-of-day fares will find political acceptance. Contrary to the fears of some transit officials that time-of-day fares pose too many confrontational possibilities between users and drivers, relatively few instances of such problems were found. this is undoubtedly due to the discretion drivers exercise in enforcing time boundaries. Importantly, the adoption of run-based collection policies rather than the strict interpretation of time facilitated collection in a number of areas. Along with on-board signage, run based collection has virtually eliminated fare confrontations and has provided the flexibility necessary for time-of-day pricing to operate efficiently.

Marketing was also found to be an important factor. In particular, the active promotion of fare differentials as off-peak discounts rather than peak surcharges served to build public support in a number of areas. Extensive advertising and mailing campaigns also proved to be effective. Although private sector promotion of the fare programs was fairly modest in some communities, there were some instances of free tokens and store coupons being issued flex-time work arrangements being initiated. Together, carefully designed collection and marketing strategies gave rise to widespread public acceptance of time-of-day pricing in the vast majority of areas.

Chapter Eight

Politics of Implementing Transit Fare Programs: Case Studies of Cincinnati, Columbus, Washington

8.1 Introduction

8.1.1 Fares and Politics

To say that fare policy decisions are "political" is to state the obvious. Fare decisions determine how public resources are going to be spent and how the distribution of costs and benefits among competing interests is going to be balanced. Such choices are the business of politics. The question here is "what kind of politics?" While fare decisions have been made in public agencies for decades, the idea of time-of-day pricing is fairly recent. It may then be useful to examine the political environment surrounding adoption of such fares by asking the following questions:

- What are the principal influences on fare policy?
- What groups or individuals are most involved in fare decisions, and what are their interests?
- By what process are fare decisions reached?
- How does the transit agency develop fare policies?

8.1.2 Case Study Approach

Three case studies were conducted, involving preliminary telephone contacts and on-site interviews with selected transit managers, professional staff, policy board members and, where possible, bus drivers and news media representatives. The selection of case study sites was not intended to be a representative sample in a statistical sense. The number and location of the case studies was a result of time constraints and the ability to coordinate and schedule interviews. The resulting analyses nonetheless present an interesting range of political settings for time-of-day fares. The principal caution, however, is that the three sites are all large metropolitan areas (1 to 3 million population). It is doubtful that direct parallels can be drawn for smaller, more homogeneous settings.

Each case study is described in a similar format, followed by a concluding section to draw together the main themes:

1. Key political factors - a summary of major findings
2. Organization and funding - an overview of the basic environment of the transit agency
3. Political structure and the fare process - a detailed description of the history of fare changes, the process for establishing fares, the political interests of the jurisdictions involved and the role in the process played by staff, board

members and other actors.

4. Role of time-of-day fares - a summary of the significance of time differentials in the agency's overall fare structure

5. Conclusions

8.2 Cincinnati, Ohio

8.2.1 Introduction: Key Political Factors

Cincinnati's time-of-day fare differential has been well received in local political circles largely because many consider it to be an important aspect of running an efficient bus system. The Board of Trustees consists primarily of top management personnel from large corporations headquartered in Cincinnati who have a decidely business orientation. They push management to introduce efficiency and productivity improvements wherever possible; accordingly, differential pricing has been favorably looked upon. Cincinnati's higher peak period fare is also one component of an overall pricing package which attempts to collect proportionally more from suburban residents. Along with zonal fares and a payroll tax, the City of Cincinnati, which owns all of the assets of the transit system, has used time-of-day pricing to increase the contributions of non-residents and to redress what many consider to be disparities between the abilities of suburban versus city dwellers to pay for transit.

The key political forces which have shaped the evolution of differential pricing in general and time-of-day pricing specifically in Cincinnati, then, have been the business orientation of community leaders and suburban versus central-city politics. These issues are probed in more detail in the remainder of this section.

8.2.2 Overview: Organization and Funding

The Southwest Ohio Regional Transit Authority (SORTA) was formed in 1968 to acquire the Cincinnati Transit Company, which was on the verge of bankruptcy, in order to preserve regional bus transportation and place it on sound financial footing. Public acquisition in 1973 helped to reverse the downward spiral in ridership and service levels since the late sixties. Indeed, ridership grew from 17.2 million annual passengers in 1972 to well over 30 million by the decade's end. Total miles and hours of service grew by one-third over the same period. The trade-off, however, was a dramatic decline in the system's cost recovery rate, from 113% in 1970 (a $1.23 million profit) to 35% in 1981 (a $23 million loss).

One of the first actions by SORTA was to secure alternative funding to the farebox. In 1971, Cincinnati's base fare was 55 cents (coupled with finely graduated concentric zones), one of the highest in the country at the time. Both property and sales tax initiatives to set aside funds for transit were soundly defeated by the voters of Cincinnati and surrounding Hamilton County. The decisive votes against the initiative came from suburban residents who ostensibly feared that they would have to shoulder a disproportionate burden for a system which would predominantly serve the central city.

In retrospect, this initial defeat served to alienate and divide various central city and suburban interests in the area. The City of Cincinnati, believing it had very little recourse, proposed an earnings tax to be levied on the wages of all persons and business interests generating income within the city limits, regardless of whether or not they lived there. City officials felt this would preserve public transportation in Cincinnati while also spreading the financial burden evenly among city and non-city dwellers alike. In 1972, a 0.3% earnings tax dedicated to support public transit was passed by a substantial margin of Cincinnati voters, on the heels of a public promise that fares would be lowered from the 55 cents base level. The earnings tax receipts, along with the city's full faith and credit, enabled Cincinnati's City Council, not SORTA, to purchase all of the assets from the private company and thus gain policy control over the system's operations. Consequently, SORTA had the financial backing it needed, but because of its inability to establish a regional consensus, saw decision-making power revert to the city. This sequence of events made for strange bedfellows and set the scenario for the politically-motivated fare structure which was to emerge.

This organizational structure is, in the eyes of some observers, a difficult and sometimes unworkable arrangement. As owners of the system, Cincinnati's City Council controls all assets and makes all final decisions on the budget, fares, and service changes, in both the city and county. The SORTA Board of Trustees is appointed by the Hamilton County Board of Commissioners, with four of the nine members recommended by the City Council. The formal operating division of SORTA is the Queen City Metro, the name the transit system often goes by. SORTA initiates and recommends all actions to the City Council for final resolution, with Cincinnati's elected officials not always following the wishes of the Board.

Thus, the City of Cincinnati has allowed a regional authority to oversee and operate the transit system, but has chosen to retain all final controls and policy-making authority. In some sense, this arrangement has pitted city and suburban interests against one another in many financial deliberations and has spawned what some consider to be an adversarial relationship between SORTA and the City Council. The inability of SORTA to secure a regional dedicated tax base, combined with the City's success in establishing a fairly innovative earnings tax source, has led to this arrangement.

8.2.3 Political Structure and the Fare Process

Fare History and Process

In April, 1973, the City of Cincinnati made good on its promise to lower adult cash fares. Base rates fell from 55 cents to a quarter. In addition, a coarser eight zone system replaced the previous one. The eight zones were not concentric, but rather politically drawn. The City of Cincinnati became a single zone (from a previous six zones). Also, premium surcharges were collected on certain express services to outlying areas. In response to federal requirements, SORTA, with the City's concurrence, later initiated a ten cents fare for senior and handicapped riders during non-peak periods. This differential proved to be the genesis behind the eventual introduction of time-of-day pricing for all

system riders. The State of Ohio offered to underwrite the revenue losses sustained from these special discounts, however for the first several years no assistance was received because SORTA insisted on using the funds for service expansions rather than for offsetting deficits.

The time-of-day fare differential was instituted in 1978 when SORTA raised fares for the first time under public ownership. The adult cash fare for weekday peak hours was increased to 35 cents while for all other times it was raised to 30 cents. Several subsequent increases have witnessed the widening of the differential to 60 cents during peak periods and 50 cents for all other times. Thus, for those choosing to ride during off-peak hours, transit fares are actually less than they were twelve years earlier.

Fare proposals in Cincinnati have historically been initiated, developed, and negotiate by SORTA's management staff, at the policy direction of the Board. The Board has generally taken a reactive posture with regard to fare policy. However, in that the Board is comprised of powerful members of Cincinnati's business and industrial community, it has always been sensitive to pricing issues and has insisted upon efficient, cost-based fare programs. Based upon staff interviews, it is also clear that the support of several powerful groups, such as the editorial boards of local newspapers and the Chamber of Commerce, is necessary if any fare increase is to withstand public resistance. Again, final fare decisions are made by Cincinnati's City Council, whose general philosophy has been to keep central city fares low and service qualities high. SORTA has been caught in the web of appeasing the council's constituents by keeping fares low while at the same time trying to maintain a financially healthy transit system.

Jurisdictional Interests

Cincinnati's fare structure has evolved along jurisdictional lines, producing a central city versus suburbia schism of sorts. The City Council's ownership has shaped a fare policy based on, in the opinion of some interviewees, fairly narrow vested interests. The City Council has consciously sought to depress base level fares supplemented by peak period and zonal surcharges aimed at suburban commuters. Together, the earnings tax, zonal fares, and time-of-day pricing have created a highly differentiated funding package, with relatively high levels of financial support generated from those living outside of the city limits. City officials maintain that this arrangement is the most equitable, which given the higher costs associated with longer-haul, peak period services may very well be the case. Although some SORTA staff and board members have viewed the City Council as being parochial in its attitude, the fact that suburban residents have continued to patronize SORTA at increasing rates suggests that the current price structure is generally perceived to be fair.

Although from the City's perspective SORTA's fare structure is considered to be equitable, the fact that zonal boundaries do not follow a rational concentric pattern as they emanate from the central city suggests there is some room for improvement. Zone boundaries follow along clear political lines, and from a map give a distinct gerrymandered impression. The City of Cincinnati constitutes the base fare zone, while some outlying zones have diameters only half the size of the

city's. Thus, the structure allows residents of far northwestern Cincinnati to enjoy relatively low fares while those of outlying jurisdiction who travel between several narrow zones might pay a decidely higher fare. Overall, however, suburban residents have shown much greater concern over SORTA's service than fare policies.

Role of the Staff

SORTA's staff has the full confidence of the Board of Trustees and therefore has played a major role in the deliberation of fare policy. Despite three changeovers in the General Manager position since SORTA's inception, support for price differentiation has been unwaivering at the staff level. SORTA staff have initiated an extensive service evaluation program in addition to an annual fare review process. A rich financial, operations, and ridership data base has been maintained for carrying out these tasks. Top management has continued to support time-of-day pricing because of the prevalent view that costs can be most efficiently covered through differentiating peak and off-peak fares. The recurrent question staff has been wrestling with is just exactly how wide of a differential should be set. There's a general opinion that the differential should be widened, however most feel that evidence on the impacts of the current fare program needs to accumulate before determining exactly by how much. SORTA's staff readily acknowledges that fare decisions are shaped more by political than economic factors in Cincinnati, however there's considerable confidence that a more substantial time-of-day differential could be sold to policymakers. Staff feels that time-of-day pricing has become so institutionalized in Cincinnati that a gradual widening of the differential would be politically acceptable.

8.2.4 The Role of Time-of-Day Fares in Cincinnati

Although price differentiation by time-of-day emerged primarily as part of the City Council's politically based funding program, several other motivating factors were also behind it. Noting the significant increase in midday usage among senior citizens following the initiation of the 1975 discount program, SORTA officials believed that similar increases would occur among the general riding public if incentives were extended. SORTA marketed the differential as a "bargain" program in hopes that once riders began trying transit at the lower-priced periods, they would continue to patronize it. The differential was also part of a larger effort to project SORTA in a positive public relations light. Initially, the differential was purposely held at a nickel to prevent major revenue losses. Additional objectives were to give lower-income and discretionary travellers a break at the farebox, to encourage ridership shifts to lower-priced periods, and to more closely approximate marginal costs.

The effects of Cincinnati's peak/off-peak differential on ridership, revenue, and operating efficiency to date appear to have been mixed. System ridership initially rose by nearly 7% following the 1978 time differentiation of fares, but has since fallen over the past few years, in all liklihood due to local recessionary factors. Much of this loss has been from the ranks of off-peak users. From several on-board surveys, moreover, no discernible shifts in usage from the peak to the lower-priced off-peak have been measured over the past five years.

SORTA planners generally believe that the absence of significant ridership impacts can be attributed to the relatively small size of the differential, which with inflation has eroded to a token amount.

System revenues have increased at about the same rate as rising costs over the past five years of peak/off-peak pricing such that SORTA's farebox recovery rate has hovered between 35% and 38%. SORTA's current costing models suggest that the peak is continuing to return a smaller share of its costs (27%) than other time periods, so a widening of the differential remains a realistic possibility.

8.2.5 Conclusions

Despite an unusual organizational arrangement, a functional and reasonably equitable pricing program has evolved in the Cincinnati area. Time-of-day fares, along with zonal pricing, have become so institutionalized that price differentiation is no longer a major issue. All sides generally agree that differential fares will be around for a long time; if any fare policy change is to occur, note insiders, it will more likely involve issues such as exact change requirements and transfers.

SORTA's Board has emerged as a staunch supporter of differential pricing, owing largely to the strong business orientation of its members. However, its fare policy role has been relegated somewhat to an advocacy one, with the ultimate decision-making power resting with city officials. This arrangement has led to somewhat strained relationships between the two groups, often placing SORTA in the position of the negotiator among narrow, special interests. In the views of some persons interviewed, the relationship is not a healthy one. One interviewee characterized SORTA as the "whipping boy" -- there to shoulder the burdens of running a transit system day-to-day, to appease competing political factions, and to take the blame whenever something goes wrong. Until SORTA can secure a stable dedicated source of funding at the regional level, however, its role will likely remain unchanged.

In sum, Cincinnati's time-of-day fare program is largely an artifact of geo-political forces which favor higher fare rates for rush-hour suburban commuters. Despite some infighting among various elites within the community, there has been overwhelming community-wide support for public transportation in the Cincinnati area, including the way it is priced. Even though the ridership and financial impacts of recent fare changes have been modest, SORTA management feels a strong commitment to time-of-day pricing and is seriously contemplating widening the differential.

8.3 Columbus, Ohio

8.3.1 Introduction: Key Political Factors

In a low-density, automobile-oriented setting like Columbus, broad community support is needed to maintain a regional commitment to transit. Fare policy has been one of the tools used in Columbus to gain that support. A package of fare reductions and restructuring was promised as a major part of the successful campaign for an area-wide sales tax dedicated for transit. With the sales tax up for renewal in 1985, the transit agency devotes considerable effort to ensuring that campaign

promises are being honored and that its public image in city and suburb, for riders and non-riders, is kept unblemished. The midday downtown "Free-for-All" no fare zone and the 24 cents midday discount are just two components of a larger effort to show local taxpayers that they are receiving good value for their investment.

Balancing this high-visibility, promotional approach to selling transit to the public is a conservative political establishment which is uneasy with the current fiscal realities of public transit: fares which cover a small proportion of costs, needs for continued tax support, and relatively highly paid transit employees. In order to maintain the support of this group of political influentials, the transit agency must demonstrate to them that it is managing its resources as efficiently as possible and is employing sound business practices to control costs. These interests maintain pressure to increase the riders' contribution to the cost of service and to see that increased revenues from fares or taxes go toward service improvements rather than to higher transit employee wages. The interplay of these two forces, an aggressive, merchandising approach to giving the public the transit service it wants, and a business-oriented, conservative coalition that does not like to see tax money given away, shapes transit fare policy in Columbus.

8.3.2 Overview: Organization and Funding

The Central Ohio Transit Authority (COTA), which serves the City of Columbus and suburban Franklin County, is governed by a thirteen-member Board of Trustees. Trustees are appointed by the jurisdictions: seven from the City of Columbus, two from Franklin County and four from the other cities in the county, on a rotating basis. Membership includes local elected officials, civic leaders and business and professional people.

COTA was formed in 1974 to take over bus service from the private operator in the region. Local operating support was from a 0.8-mill property tax in the County, but proved insufficient to fund service improvements and expansions. In 1979, a sales tax levy was sought but failed by 48% to 52%. A variety of factors contributed to the defeat, illustrating the political structure of the community. The 1979 measure was proposed by COTA in what some now see as a naive manner. The proposal was technically sound and logical, arguing that a permanent tax base be established to fund improvements and to restore services that had been cut in the past. The appeal was nearly successful, with the margin of defeat attributed to COTA's inability to line up support from the community at large and from the central political actors in Columbus. To some, the sales tax seemed regressive, while others thought it would place too much money into the hands of another government bureaucracy. One telling event was a misunderstanding over one minor item in the proposed transit capital improvement program -- equipping the fleet with two-way radios. The dominant newspaper picked up the fact that the proposed two-way radios would cost $3,500 per bus, while common citizen's band radios could be purchased for under $100. Citing this as an example of wasting taxpayer's money, the newspaper rallied opposition to the levy. The campaign for the levy got off to a late start and was, it turned out, underfinanced. COTA had failed to clear the way for its proposal with the existing power structure and their lack of support or active opposition led to the defeat.

Having learned its lesson, COTA immediately laid out a strategy for bringing the measure back to the voters and contacted the key political leaders within two weeks of the ballot defeat. The Chamber of Commerce, newspaper editors, the mayor and others were sought out to determine what was best for the community. The new proposal reflected the variety of concerns the political structure had: supporting the central business district, filling the empty buses that were so visible downtown, improving service in outlying areas and making sure that new funds were devoted to service expansion and equipment improvements rather than higher wages. A well-financed, professionally managed campaign was mounted, targeting the most critical precincts with information about what the proposed levy would mean to its residents. A "something-for-everyone" package of promises was developed that gained the support of the newspapers (the two-way radios were dropped from the plans) and resulted in passage of the 0.5% sales tax in 1980 by a vote of 57% to 43%. Lower midday fares were part of the package of promises.

In fiscal year 1982-3, the sales tax contributed about $10 million to the operating budget, compared to about $8 million from fare revenue and $2 million in other operating revenue. The balance of COTA's Fiscal Year 1983 budget of $27 million came from federal ($4 million) and state ($3 million) operating assistance. By state law, 0.5% was the minimum sales tax that could be applied, although this was thought to be higher than necessary for supporting current operations. Consequently, under the terms of the 1980 levy, the sales tax is only authorized for five years. There is to be no tax levied in the sixth year, thus making use of the accumulated reserves from the first five years. The tax will then go before the voters for renewal in 1985.

8.3.3 Political Structure and the Fare Process

Fare History and Process

Upon taking over the private operation, COTA set adult cash fares at a flat 50 cents (75 cents for express service). Zone charges were eliminated because of the relatively short trip distances in the county. The higher fare for the express routes served as an effective zone charge for those longer trips. This structure remained in effect from 1974 through 1979. When the first attempt to pass the sales tax levy failed, the base fare was raised to 60 cents, as COTA had warned would be necessary to fund operations. Among the promises made in the 1980 levy campaign was that fares would not be raised until 1983. Thus, COTA has not had a great deal of experience with changing fares.

COTA's fare proposals are developed and analyzed by staff, led by the General Manager and the Assistant General Manager for Administration and Finance. Fourteen local neighborhoods commissions, senior citizen groups, and a handicap consumer advisory committee provide input along with the general public through the public hearing process. Board members are exposed to fare issues in advance of fare deliberations at special workshops in which staff work out examples of fare changes and their likely revenue and ridership consequences.

The General Manager was the main proponent of the "Fare Incentive Program," a package of fare reductions that was an integral part of the 1980 promises. The underlying theme was that passage of the sales tax

would allow fares to be held constant or reduced so that more people could take advantage of the new services. Fare reductions included a free midday downtown zone, 25 cent midday fares outside downtown, a new monthly off-peak pass, a new midday daily pass, and reduced prices on the local and express monthly passes. This package had broad political appeal. Downtown workers, many of whom normally did not use transit, would have the opportunity to directly benefit from their tax payments. Low-income residents could save money at midday. Suburban riders would have reduced fares midday as well as expanded service. Regular commuters both inside Columbus and from the suburbs would enjoy lower-priced passes. This broad distribution of benefits was no accident, but rather deliberately assembled to gain political support for the levy from all quarters. The time-of-day differentials were a key part of the overall package of promises.

The general Manager had to sell the idea of reduced midday fares to both his board and a skeptical staff. The expected revenue loss could only be justified by the expectation of more than offsetting sales tax revenue. COTA traded off fare revenues, which were relatively stable, for a tax source which promised long-term growth and sufficient revenue to fund substantial service expansions. The deal was a good one for COTA, and it has been trying to convince its taxpayers, by delivering on fare reductions and service improvements, that it was a good deal for them, too.

Jurisdictional Interests

Relationships among COTA and its constituent jurisdictions are relatively harmonious, but there are still the basic city/suburb divisions of interest that occur in most metropolitan areas. The interests of the central city's business community are in developing and enhancing the downtown, even though outlying jurisdictions are themselves developing new job and shopping functions. The downtown free-fare zone (which replaced a reduced fare zone) was an explicit device to promote retail sales in the core. There is a continuing current of suspicion by some suburban interests that support for COTA, its fares, and its sales tax boosts downtown retail sales at the expense of outlying merchants. There is no factual basis, however, to test these suspicions. The inner city residents are typically more dependent on transit and have more services available to them due to historical radial routing of the system. Outlying residents are more automobile-oriented, both using transit less often (or not at all) and having less service available to them. The COTA Board members see one of their main responsibilities as keeping these city/suburb interests in balance so that the total community remains behind COTA.

This balance has been achieved in several ways. First, in its 1980 campaign and subsequently, COTA has repeatedly stressed the importance of viable transit service to the general economic well-being of the region. The recent poll of County households confirms that public support for COTA remains high, even though more than 80% of Franklin County households do not patronize the system. Second, the package of promised service improvements included expansion of routes into outlying areas. Even though some of these services are acknowledged to be of marginal efficiency, they are nonetheless maintained in order to demonstrate COTA's evenhandedness in serving all segments of the community. By

"showing the colors" in outlying suburbs, COTA is able to maintain a presence in the public's mind that is expected to pay off at the polls in 1985. Third, the Fare Incentive Program included in the midday fare specifically to benefit those in outlying areas who would not directly benefit from the downtown free zone. The pass discounts similarly benefit the regular commuters from outlying areas to the downtown. These explicit incentives, true to the program's name, are intended to benefit existing riders with immediate cash savings, attract new riders by making it easier to try out transit and demonstrate to the taxpaying public at large that COTA is providing bargain service.

While each Board member represents jurisdictional interests, all members interviewed volunteered that the COTA Board was not a "political" group -- i.e., local politics do not enter into their decisions. None could recall an instance of controversy between COTA and local officials which forced Board members to take sides. There are two possible explanations for this. First, Board members who are not themselves elected officials noted that they try to stay in touch with the mayors and councils in their areas on all important issues. Furthermore, some of the members appointed by the City of Columbus actually reside elsewhere in the County, thus assuring a geographic mix that crosses jurisdictional boundaries. The result is that proposals such as the time-of-day differentials may be reviewed and modified by representatives of all concerned jurisdictions in advance of formal public discussions.

A second possible explanation of this relative harmony was also suggested by Board members, staff and news media representatives. They all pointed to a conservative local power structure comprising a small number of individuals in private and public life whose approval was needed in any major undertakings. They were given credit for preserving public transportation when the private company failed. They were also identified as a major reason the 1979 sales tax levy was defeated, and why, once their concerns were satisfied, the 1980 levy passed. Board members and management stated that they already know that certain of these key individuals are concerned about the low farebox recovery rate, "giving away" midday services and relatively high employee wages, and that COTA must effectively deal with these concerns to gain support for the 1985 tax vote. Although these shapers of public opinion were not interviewed, it was apparent from discussions with others that a tightly knit power coalition wields great influence on fare policy in Columbus.

Role of Staff

COTA's Board members rely heavily on staff to bring them information and recommendations, generally wishing to set policy for the staff to carry out rather than getting directly involved in managing the operation. Only a few Board members expressed any concern that the staff was playing too strong of a role. Two Board members echoed the feelings of several of their colleagues that the Board would work with the COTA staff to do whatever is necessary to build the coalitions needed to renew the sales tax. Still, one news media representative characterized the COTA Board as a rubber stamp for staff recommendations, noting that the Board had only voted against the staff twice in its history. This may simply be evidence of good staff work -- keeping Board members informed, finding out what their concerns are, and

bringing them along as recommendations are being developed. Rubber stamp or not, it is evident that Board members highly respect the COTA staff.

The fact that the General Manager has been in office since 1977 is an indication of the stability of the staff. He has succeeded in maintaining good relations with the Board while introducing a variety of changes in fares, services and marketing. There are often several changes each year, in addition to the specific improvements promised in the 1980 campaign. These continuing changes led one driver to complain about management's keeping the system "in turmoil." The General Manager's experimental nature has resulted in COTA's undertaking some of the more innovative transit projects in the country, projects in the country, including automatic passenger counting devices and automated telephone information services. Since he has the confidence of his Board, he has been able to propose these changes and follow them through. Although some Board members see some of the marketing efforts, including the midday fare reductions, as "gimmicks," they remain behind the General Manager's overall program to keep COTA a high-profile agency.

Other Political Factors

Both major newspapers cover every COTA Board meeting and their support is recognized as essential to COTA's future, just as their opposition in 1979 led to defeat of the sales tax proposal. Even though Columbus is the state capital, the county seat, the financial and industrial hub of central Ohio and the site of the main state university campus, COTA seems to remain in the media limelight. This may be attributable to COTA's own aggressive marketing campaigns, and to its outreach efforts to community groups and civic organizations.

The transit labor union was initially against the reduced midday fares in the belief that reduced revenues would impact their labor settlements. The union also went to the press with the argument that reducing fare revenue would be bad for the fiscal health of the system. The most recent union strike in 1982 resulted in a settlement that gave COTA drivers the highest wages of any transit system in Ohio. The memory of the 17-day strike and the high wage settlement leave much of the public and members of the power structure worried that the situation might recur. COTA Board members and management are sensitive that the public may perceive that sales tax revenue will be used to boost driver's wages instead of improving service. They are especially concerned that the next contract negotiation be concluded by the November, 1984 deadline without a strike and without further promoting a widely held perception that COTA employees are overpaid. Otherwise, support from the conservative power structure for the 1985 tax renewal could be in jeopardy.

As in most large transit systems, union representatives are not actively involved in fare deliberations, nor routinely consulted on operational matters. Interviews with driver representatives revealed a far more negative perspective on time-of-day pricing. First, they believed that many riders still did not understand the fare differential, especially the pay-on-exit procedure with different rules in the morning and evening. Second, they believed that significant

overcrowding because of the midday free fare prevents paying customers from boarding and greatly reduces the quality of service. Third, they see the pay-on-exit process for out-bound trips as a major cause of schedule delays. Fourth, they think that the lack of strict enforcement of fare collection, which they attribute to COTA's desire to avoid any bad publicity, contributes to fare abuse. Only the third issue, the pay-on-exit process, had been mentioned by management staff as a problem. If the other allegations are true, and the problems are not dealt with effectively, there may be significant latent opposition to the time-of-day differentials which could play a role in the 1985 vote.

8.3.4 Role of Time-of-Day Fares in Columbus

Fares currently cover about 30% of COTA's operating expenses. If the $500,000 estimated to have been lost due to the midday discount and free downtown zone were collected, it would boost the farebox return to only about 31%. The steady flow of sales tax receipts has simply made fare revenue, and revenue lost from the midday discounts, less important. Some Board members and members of the local power structure would like to see COTA riders pay a higher proportion of the costs. This is partly a philosophical concern over the role of subsidy in public transit, but also reflects a practical concern over the impending 1985 tax renewal vote. There is a strong feeling that the great majority of voters who are paying the tax but not riding must be shown that riders are shouldering their fair share of the financial burden. The midday discounts may have to be reduced, if not eliminated, in the future to maintain support from certain sectors.

Generally, there has been a positive response to the time-of-day differentials. The goal of filling the midday buses downtown has been achieved to the point of severe overcrowding on some routes. Some riders arrange their trips to take advantage of the free period and acknowledge that they are saving money at the farebox. A recent general opinion poll about COTA revealed broad public support among riders and non-riders alike, and a feeling that COTA was reasonably priced. Still, some feel that the midday discounts are giving away needed revenue and forcing some riders to pay more so others can ride for free.

One of the intended results of the downtown free zone was to make use of available midday capacity since most routes serve downtown. The politically practical also wanted to increase midday ridership, not so much to make better economic use of capacity, but to counter the public's image that there were too many empty buses on the streets. Filling those buses, by whatever means, would be further visible evidence that public transit service is widely used and deserving of continued tax support. The two midday fare programs (25 cents systemwide, free downtown) have achieved that goal by establishing the midday as the new COTA peak ridership period, with the highest passengers-per-hour counts now recorded between 9:30 a.m. and 3 p.m.

Despite this apparent policy success, some Board members believe that there is no long-term commitment to time-of-day differentials. Instead, they feel that the next fare adjustment will incorporate whatever elements are needed to maintain public support, garner the backing of the power structure and meet financial needs.

8.3.5 Conclusions

The single driving force behind COTA at present is to guarantee renewal of the sales tax in 1985. One COTA staff member referred to this as COTA's "socialization" process, since all staff are imbued with the list of promises made in 1980 and the need to diligently keep them. Staff maintain a list of those fare and service promises alongside a schedule of accomplishments and plans for implementation. Few agencies have such a clear yardstick for measuring their progress. In this context, time-of-day fare differentials were only one part of a total package of improvements and expansions focused on giving some fare or service benefits to as many segments of the community as possible. There is little feeling that time-of-day differentials are essential or that the economic rationale for such fares is convincing by itself. At present, the midday fare discounts are viewed as important marketing tools that serve the greater policy purpose of solidifying public support for COTA.

8.4 Washington, D.C.

8.4.1 Introduction: Key Political Factors

It would be difficult to imagine a more byzantine political environment than that facing public transportation in the Washington metropolitan area. Every level of government in the U.S. has a stake in running transit in the region-- two states, the District of Columbia, four counties, three cities and the U.S. Congress. The effects of government by committee show. Recognition that transportation was a regional problem led to the formation of an area-wide agency to integrate and expand transit service. The political realities of the region, however, stacked the deck against that agency's functioning as an effective, independent entity. This is clearly shown in the manner in which public transportation is funded and priced.

Each jurisdiction faces a unique blend of fiscal constraints and holds a narrow view of its constituents' needs. This produces fare structure decisions that are more the chance result of competing interests than the deliberate execution of a coherent fare policy. The time-of-day differentials that have been adopted, modified, dropped and reinstituted over a period of eight years have never been implemented in the context of a consistent regional fare structure. Instead, each annual change represents only the latest attempt to muddle through another fiscal year's negotiations. Many staff members and some policy board members hold to the belief that time-of-day pricing should be continued as an appropriate way to equitably recover operating costs, but the overall complexity of the total fare structure will probably preclude any determination whether such pricing generates any of its intended benefits. Time-of-day pricing will likely remain simply one more instrument in the annual inter-jurisdictional negotiations over funding, subject to unpredictable year-to-year swings.

8.4.2 Overview: Organization and Funding

The Washington Metropolitan Area Transit Authority (WMATA) was formed by interstate compact in 1966 to develop the regional rail rapid transit system, following six years of study by the National Capital

Transportation Agency. In 1972, WMATA was given authority to acquire the four privately-owned bus systems in the region, which was accomplished in 1973. The first rail service in the planned 101-mile system opened in 1976 and there were 47 stations and 42 miles open by 1983.

WMATA is governed by a board of directors which is appointed from the constituent jurisdictions. Two directors and two alternates represent each of the three major jurisdictions -- the District of Columbia and the Virginia and Maryland suburbs. Each state formed special commissions to coordinate local government participation in WMATA. The two Virginia directors are appointed by the Northern Virginia Transportation Commission, which encompasses Arlington and Fairfax Counties, the cities of Alexandria, Fairfax and Falls Church and representatives of the Virginia Department of Transportation. The Maryland directors are appointed by the Washington Suburban Transit Commission, representing Montgomery and Prince George's Counties and the Maryland Department of Transportation.

There is no dedicated regional source for WMATA's funds. There are special agreements dealing with funding for construction of the rail system which specify the extent of federal funding and local match requirements. For operating revenues, each jurisdiction has a different arrangement. Both states allow local governments to use only property tax revenue to support transit operations. Special enabling legislation would be required in each state to allow sales or other dedicated transit taxes to be imposed by the local governments. Virginia earmarks a 2% gasoline sales tax to assist the local jurisdictions; Maryland provides funds for up to 75% of unfunded operating deficits for its local governments. The District of Columbia earmarks a variety of its local taxes for transit, and its budget is supported by annual Congressional appropriations. WMATA also receives federal operating assistance under existing formula grants.

Two different approaches are used to determine the amount of operating assistance each jurisdiction is responsible for contributing to WMATA. For bus service, each jurisdiction effectively "buys" service from WMATA. The costs of bus service are allocated to each jurisdiction based on the amount of service (vehicle miles and hours) assigned to it by a complex accounting process. Revenues attributable to riders using that service, based on periodic ridership surveys and fare records, are then used to offset the assigned costs to determine the remaining deficit the jurisdiction must provide through its own revenue sources. For rail operating costs, the total systemwide rail deficit is apportioned among jurisdictions by a three-factor formula (number of stations, population and residence of rail patrons).

8.4.3 Political Structure and the Fare Process

Since taking over the private bus operations in 1973, WMATA has modified bus or rail fares eleven times. A time differential has remained through all the fare changes, but the amount, direction, and consistency between modes has varied considerably. At one point, for instance, the rail minimum peak period fare was set below the off-peak fare, although bus fares were in the more usual relationship. Initially, fare changes were instituted to simplify the structures of the previous four private bus operators. It was not until 1981 that WMATA

took a step toward fare simplification by adopting a uniform boarding charge of 60 cents in all jurisdictions, at all times, for both rail and bus. This erased many time-of-day differentials in the fare structure, but others were maintained in distance charges. The uniformity lasted only one year, when the District reintroduced the 5 cent peak differential it had in 1980. This is just one example of the lack of consistent direction in fare policy and the on-again, off-again application of time-of-day pricing. A detailed chronology of these changes can be found in Appendix I.19.

Bus and rail fares beyond the boarding charge are considered separately due to the fragmented funding situation and the need by each jurisdiction to guard its fare revenues. One Board member repeated the truism understood by Board, staff and riding public alike: "the fare structure is dictated by politics." It is not that politics "influences" fares, or that political considerations are taken into account when developing fare proposals. The operative work is "dictated," and it is meant seriously.

The WMATA Board has informally adopted a policy of annual fare revenue reviews, with an eye toward increasing the fares to keep pace with inflation. Fare proposals are developed by a process of negotiation among WMATA staff and the staffs of the District and the two state commissions. Revenue projections by WMATA staff indicate the magnitude of fare change required to fund the deficit. WMATA staff then propose changes to the General Manager who presents a proposal to a committee of the Board. The jurisdiction staffs respond with their own proposals and the staffs then work together to arrive at a consensus package to take to public hearing. The staffs, however, have no authority to negotiate political issues, only technical ones on computation of fare revenues and assignment of costs.

In this process, each jurisdiction's revenues must be protected and each has effective veto power over the resulting structure. Each jurisdiction has substantial independence in proposing bus fares because the fare revenue generated by riders in its area determines the amount of the WMATA bus operating deficit which it must subsidize. With every jurisdiction facing the same situation, there appears to be a general understanding that one jurisdiction will not interfere in another's bus fare proposal which has only local (intrajurisdictional) revenue impact. Once the proposal goes to public hearing, it can only be reduced by the Board, not increased, so there is a bias toward proposing higher fares than are eventually expected to be approved.

Jurisdictional Interests

Board members are usually elected officials and therefore tend to be sensitive to the revenue impact of WMATA's fare decisions on their jurisdictions. Some of the jurisdictional interests have a very familiar ring. The central city wants to keep base fares low for its low-income, short-distance travelers and wants long-distance, affluent commuters to pay higher fares in the forms of both distance charges and peak period surcharges. Suburban jurisdictions want simple, flat-fare structures and do not want to subsidize central city riders, although they may accept a time-of-day differential as a reasonable distinction. There is a clear and deep-seated "us" and "them" attitude common to city

and suburb. In addition to this traditional competition between central city and suburban interests, there are the further complications of different levels of state support and different philosophies among the component cities and counties. Just as the central city is pitted against its suburbs, the metropolitan suburbs are frequently at odds with their state legislatures. These up-state/down-state rifts occur on a variety of topics, not just public transportation, so they are a recurrent problem independent of political issues in the Washington metropolitan area.

The Federal government, deeply involved in the financing of the construction of the rail system, is generally removed from WMATA's operating funding. With one glaring exception, the U.S. Congress has not been involved with WMATA's fare process. In 1976, the Appropriations Committee cut the District's budget by over $2 million, an amount which the Committee said should be made up by raising the peak period fare by 10 cents (the same differential that Maryland and Virginia had since 1975). After much protestation by the District Council that the fare was "an imposition by the U.S. Congress of suburban values into the D.C. transportation system," the increase was introduced in 1977. Since then, the Congress has not chosen to be involved in WMATA's annual fare ritual, although it is within its power to influence the District's funding at any time.

Each jurisdiction must closely watch the cost and revenue allocation formulas which determine the amount of funds it must contribute toward WMATA's deficits. Each jurisdiction therefore usually seeks to spread costs across the system and set allocation formulas which benefit it. In general, the District and Arlington County (the jurisdiction nearest downtown Washington) are interested in higher mileage charges, which affect the other jurisdictions. Furthermore, the District, with a large low-income and minority population, has historically argued for low off-peak and base fares in the interest of social equity.

The result of this complex interaction is that Board members often find themselves locked into positions by their own governing bodies so that they cannot effectively negotiate fares in a regional forum. The process of renegotiating issues with the independent jurisdictions may take six months or more to work out. The result is a fare structure with little apparent uniformity across jurisdictional lines. Zone charges, transfers, and special surcharges create a complex overall structure that reflects the amalgamation of myriad separate negotiations rather than a uniform pricing philosophy. One Board member characterized the result as a "hodge-podge."

The fare structure decisions accomplish the avowed purpose of satisfying the individual revenue needs of the jurisdictions. The manipulation of cost allocation formulas and revenue factors to arrive at those agreements, however, underscores the fact that the real issue is the lack of a regional funding base for transit. Since that would require concerted efforts by two states and the Congress, few participants in the process believe that such an arrangement would be any easier to accomplish than the present process.

<u>Role of Staff</u>

WMATA's General Manager has changed three times since rail

operations began, so there has been no consistent, sustained policy direction from the top regarding fare policy. Other staff, however, have been intimately involved in WMATA's fare deliberations since the first regional fare structure was developed in 1975. They provide the basic data for the jurisdictions's staffs as well as some of the analyses of various fare alternatives.

Many of WMATA's staff are concerned about the complexity of the fare structure, but there is no consensus on the best way to rationalize it. One manager said that the fare structure was a significant impediment to increased patronage, and that it was becoming so complex that someday it would have to be radically simplified in order to continue to sell the product. While the total fare structure appears to be highly complicated, both public information personnel and one Board member noted that most riders are only interested in their usual commute fare, and therefore only have to worry about one small part of the fare structure. Only visitors and newcomers to the system are faced with figuring out their fares from scratch. Prior to WMATA's acquisition of the four private bus companies, there was a complicated, uncoordinated multi-zone fare structure in Virginia and Maryland. The current zonal system represents a significant simplification over that structure.

With so many components of the fare structure to consider, there is little wonder that staff do not agree on where to go from here. Some staff believe that fares should be lowered to maximize use of the rail system, citing the multi-billion dollar sunk cost, while others believe rail fares should be raised to reflect cost/revenue relationships similar to the bus side. A special staff committee was formed in 1983 to examine a variety of alternatives to the current fare structure, including the "state of the art in pricing policies and innovative techniques." There is general staff support for continuation of time-of-day differentials, but there is no agreement on how to deal with equity issues.

8.4.4 The Role of Time-of-day Fares in Washington, D.C.

The time-of-day differential was first introduced for the bus system by WMATA in 1975, with the support of the District staff, to encourage more efficient use of capacity and more accurately reflect costs. The definition of the peak period was extended in 1976 to 6 to 9:30 a.m. and 3 to 6:30 p.m., primarily to protect fare revenue, but the broad definition did not meet with the approval of one citizen at the January, 1983 fare hearings:

> Please define the peak as rush hour -- 7:30-9:00 a.m. . . . The peak of a mountain is not at the base, it's not half-way up, it's at the tip-top. So when is your peak fare? When is your peak ridership? It's not at 6 o'clock in the morning. It's not at 7 o'clock and it's not at 9:30.

A peak period so broadly defined clearly can have little impact on shifting riders from one period to another. Even with flexible working hours, which the Federal government had promoted for its employees, few commuters could benefit from lower fares by changing their travel times.

Currently, there is no time-of-day difference between rail and bus

or across jurisdictions for the minimum fare (75 cents). The fact that the rail system maintains a flat fare in the off-peak, regardless of distance traveled, angered another speaker at the 1983 fare hearings:

> The systemwide flat off-peak rail fare of 75 cents is unfair... Why are off-peak discounts offered only to long distance riders?... Short haul riders will respond to the same inducement as more affluent long-haul passengers.

The exception to the uniform boarding fare is the 5 cent discount for off-peak bus fares in the District. Most recognize that the 5 cent differential in the District is only a token amount. One citizen complained at the last public hearing on fares that:

> The 5 cents differential found on city buses is ridiculous. Does the Board really believe that it provides a sufficient inducement to travel off-peak? It is not worth the complexity it introduces.

The district argues that it does not want to penalize its low-income off-peak riders, nor its working-class peak riders, but that it cannot afford to lose revenue from a greater differential. On the other hand, there are up to 80-cent differentials for multi-zone bus trips and more than $1 differentials for some rail trips.

There is some redundancy in having both time and distance differentials in the fare structure. Peak travel tends to be over longer distances, so commutes may be subjected to two types of extra charges where one or the other might accomplish the same thing. The District took special steps to reduce the base rail fare for three stations in its low-income area so that working-class residents would not have to pay both a full peak and distance charges.

Fare revenues covered over 45% of operating expenses in Fiscal Year 1983, a relatively high farebox recovery ratio for U.S. systems. Looked at separately, the bus system recovery ratio was 40% while the rail system recovered 55% of costs. The Board has set a higher target for the next budget cycle, but meeting it will require cost reductions. Staff have estimated that $10 million will have to be saved to boost the farebox recovery by 1%. Further fare increases are very likely. Some Board members and staff are concerned that fares, particularly the long-mileage rail fares, are becoming too high. As stations farther out on the lines are opened, there may be pressure from those outlying jurisdictions to reduce the mileage charges. In the absence of an established regional consensus on overall fare policy goals (e.g., promotional, cost recovery, value received, etc.), future modifications to time and distance charges may be expected to occur in a piecemeal fashion. The pattern of zone, time and mode differentials is so complicated that it would be difficult to assess if they are achieving their desired effects. Since the time differentials provide yet another tool in fine-tuning jurisdictional negotiations, however, they are likely to be retained.

8.4.5 Conclusions

WMATA is not so much an independent authority as it is a loose

federation of independent bodies that regularly renegotiate the basis for their continued participation. While fare changes are a vital part of this process, time-of-day differentials by themselves are simply another means of manipulating the equations that determine jurisdictional shares of the system's deficits. The absence of a cohesive fare policy and the lack of a dedicated regional funding source make it difficult to predict whether time-of-day differentials will ever be used to achieve their desired effects.

8.5 Conclusions and Insights from Case Studies

In no case was time-of-day pricing a particularly crucial issue or a centerpiece of fare policy. The major political forces, therefore, were concerned with fare policy in general, and not time-of-day fares by themselves. The major message from these case studies is that fare policy is simply one instrument for resolving the cluster of service and fiscal issues that face transit agencies. In each case there was a local political imperative that drove fare policy. For Columbus, it was the drive to maintain a positive public image to assure renewal of the all-important sales tax. The midday discount fares proved a useful way to curry favor with a broad political spectrum. For Cincinnati, it was the dominance of the central city's interests because of its fiscal control over the transit agency. With veto power over fare proposals, the city is able to shift the fare burden to suburban riders through distance and time-of-day charges. For Washington, it was the annual ritual of renegotiating cost-sharing agreements among eight jurisdictions. As long as each jurisdiction must guard its budget from the impact of fares, Washington's fare structure will remain complex and the application of time and distance charges will be uneven.

The case studies provide a range of political settings. In all cases there is a city/suburb division of interests over fares. In Columbus, those divisions are fairly well internalized on its own board and relations are generally harmonious. In Cincinnati, there are deep divisions between the central city, the suburbs and the regional operating authority over sharing the costs of the system. In Washington, "city/suburb" does not begin to describe the complexity of competing political interests. In each case, however, time-of-day pricing has been introduced and the argument has been sustained that peak riders should pay higher fares even though they may disproportionately be suburbanites. This bodes well for other areas contemplating time differentials, but concerned over public acceptance of paying different fares by time of day. Although riders and board members may both fully understand the planner's economic arguments for peak pricing, they nonetheless see such differentials as "reasonable" pricing. This acceptance of higher fares by suburbanites, on the other hand, simply reflect indiscriminate views towards distance versus time charges.

The case studies also illustrate some of the characteristics of established theoretical models of government behavior and decision making. While pluralistic interests prevail in all three areas, there is a range from acknowledgement of a dominant power structure in Columbus, to recognition of a strong role played by business and news media interests in Cincinnati, to a dispersion of power so thorough in Washington that it virtually prevents concrete decision making. In no case, however, are there examples of purely rational decisions on fares. Technical

staff may develop a rational set of fare policy options and evaluation criteria, or may routinely conduct analyses which identify the need for additional fare revenues. Fare decisions, however, were in all cases the result of bargaining among transit agency staff and all other concerned parties. Political or fiscal expediency was the dominant factor in reaching fare decisions. Consequently, fare policy decisions were above all incremental dealing with pressing current problems and leaving the future to the future. The extreme case is Washington, where attempts at "fare simplification" may continue indefinitely.

There are no unambiguous directions from this very limited set of case studies. There is evidence, however, that in a variety of political settings, time-of-day pricing can successfully appeal to a range of interests -- equitable treatment of low-income travelers, cost recovery, charging by ability to pay, etc. Allison (1971, p. 173) has pointed out that political consensus does not require agreement on goals and objectives, and in fact such agreements may be impossible:

> Any proposal that is widely accepted is perceived by different men to do quite different things and to meet quite different needs. Misperception is in a sense the grease that allows cooperation among people whose differences otherwise would hardly allow them to coexist.

Chapter Nine

Conclusions and Recommendations

9.1 Highlighting the Findings

Evidence on time-of-day transit pricing in the United States has been reviewed in this report. A rich mix of time-of-day fare programs was found, as diverse as the American transit industry itself. Both successful and unsuccessful cases emerged from the analysis, with a host of political, economic, and environmental factors having some influence on outcomes. All things considered, the majority of areas which implemented time-of-day differentials seem to have benefitted, reflected, in part, by the decision of most to retain their programs.

9.1.1 Features of Time-of-Day Fare Programs

Since 1970, over 30 areas have introduced fares which vary between peak and off-peak hours of the weekday. Of these, 12 programs were eventually discontinued, and in 2 cases they were reinstated. As of late 1983, 23 areas in the U.S. had urban transit fares which varied by time-of-day. These 23 areas range considerably in terms of population sizes, geographic locations, and economic characteristics. Time-of-day fares are applied primarily to bus modes, though Washington's Metrorail and Orange County's dial-a-ride services also vary fares between peak and off-peak hours. Transit properties using time-of-day pricing were found to have only slightly above-average ratios of peak to base buses.

Time-of-day fare programs were found to be about evenly split between peak surcharges, off-peak discounts, and differential peak/off-peak fare increases. Interestingly, there have been no cases to date of simultaneous peak fare increases and off-peak decreases. Evidently, transit agencies fear that such a fare change would disenfranchise peak hour customers by creating too glaring of a disparity in fare rates. This is perhaps also the reason why the average differential has only been around 15 cents, ranging from only a nickel in Washington and Baltimore to 35 cents in Columbus, Denver, and Palm Springs. In relative terms, the highest differential has been Boston's 150%. For almost all systems studies, the size of the initial peak/off-peak differential has been eroded by inflation.

An assortment of prepayment provisions were also found. Six areas provided passes discounted at a higher rate during the off- peak, while four required peak period surcharges in combination with passes. Four areas also used discounted multi-ride tickets good only for off-peak periods, while two areas offer off-peak- only discounted tokens. These prepayment provisions are particularly noteworthy in that off-peak users are receiving fare incentives comparable to those enjoyed by rush-hour passholders. It stands to reason that off-peak users, whether occasional or more frequent customers, should be given as much inducements to ride transit as regular peak hour passengers.

Many properties, particularly larger ones, designated a six hour peak period. In the case of Washington's Metrobus and Metrorail, a seven hour peak has been set. While a wide time band can increase

revenue yields, it also discourages shifts in ridership between periods since the number of potential beneficiaries becomes small. The predominance of wide peak time bands in large areas reflects both the tendency for peak ridership to be more evenly distributed in these settings and their greater vulnerability to revenue losses from shifts to the shoulders of the peak. Midday discount programs, employed more by medium-size properties, generally involved a five to six hour time period designation.

From interviews, it was found that the most frequently-cited reason for instituting time-of-day differentials was to encourage increases in off-peak ridership, primarily through shifting. This was usually the primary motivation behind discount programs. The next most frequently cited reason was to increase farebox revenues, promoted mainly by areas introducing peak period surcharges. Other justifications were to design cost-based fares, to minimize ridership losses (through peak-only price increases), to help the disadvantaged, and to strengthen downtown areas. In general, all programs were politically motivated, the products of a wide array of stimuluses as opposed to any one factor.

Among the ten time-of-day programs which were discontinued, interviewees indicated that an excessive loss of revenues prompted the return to flat fares. In several areas, increases in fare disputes and other implementation problems led to the differential's abandonment. There also seemed to be a common belief in most of these areas that time-of-day fares were ineffective at inducing ridership shifts. Moreover, there appeared to be an absence of direct beneficiaries of lower off-peak fares in many settings, primarily because senior citizens, who often predominated off-peak usage, were already receiving substantial discounts.

9.1.2 Evidence on Impacts

Data limitations, stemming from the fact this research was conducted after-the-fact, restricted the analysis of ridership, financial, and equity impacts. Nevertheless, an assessment of trends associated with the fare changes provided some useful insights. Most areas which introduced off-peak discounts experienced significant gains in ridership. In fact, fare elasticity estimates revealed that discounts seemed more effective at boosting overall ridership than a comparable, at least in terms of average fare, uniform lowering of fares. With peak surcharges and differential increases, ridership consistently declined, though this varied somewhat among properties. Losses, however, generally were less than what would be expected from an across- the-board fare hike which produced the same average fare.

Unfortunately, cross-elasticities and other indications of intertemporal shifting could not be measured because of data restrictions. However, data on the distribution of ridership by time-of-day revealed that the off-peak share rose in about half of the areas which introduced discounts. Importantly, areas with the largest relative discounts and the longest designated midday periods appeared to enjoy the greatest increases in off-peak shares. In contrast, surcharge arrangements seemed to have an imperceptible influence on ridership distribution.

The econometric analysis of ridership impacts in seven areas

produced fairly mixed results. In Allentown and Akron, off-peak discounts, controlling for other factors, seemed to have few positive effects on ridership, at least in comparison to uniform changes in pricing both areas have introduced. In Cincinnati and Columbus, on the other hand, off-peak users seemed extremely sensitive to lower fares, evidenced by the respective price elasticity estimates of -.69 and -.94. And in Denver and Orange County, riders seemed to be fairly insensitive to higher peak fares, whether in the form of a peak-only surcharge or a flat fare increase. In Denver, the estimated fare elasticity from the most recent differential increase was -.22, while in Orange County it was -.31. Overall, this analysis suggests that discount programs seem to have been more effective at increasing ridership than surcharge programs have been at forestalling losses.

As in the case of ridership, the financial and efficiency trends associated with time-of-day pricing were generally mixed. Overall, cost recovery rates remained unchanged one year after the fare programs were introduced. For peak surcharge and differential increases, however, cost recovery rates generally increased 5 to 10 percent. In all cases, off-peak discount programs witnessed a decline in the share of expenses recovered from fares, with rates falling by more than 10 percent in 7 cases. There appeared to be no relationship between the relative size of the differential and financial impacts. However, the greatest gains in cost recovery were by systems which specifically sought them -- of the nine systems which set cost recovery targets, seven achieved them one year after introducing peak surcharges.

Contrary to expectations, there generally were no changes in peak-to-base ratios of vehicles to suggest that equipment and manpower were being deployed more efficiently. Only in the case of discount programs did there tend to be a slight reduction in this ratio. However, for four larger systems -- Minneapolis, Orange County, Sacramento, and Washington, the ratio of peak to base buses did decline by over 6 percent within one year of the surcharge's implementation.

The sizes of properties' labor force seemed to be unaffected by time-of-day pricing in most places. Total numbers of employees generally continued to increase following the introduction of time-of-day fares, though there were several exceptions to this. Moreover, labor productivity, as reflected by vehicle-miles per employee, usually continued along a secular decline even after the inauguration of time-of-day pricing. Undoubtedly, factors other than the fare programs themselves had a hand in this slippage.

Individual case studies revealed some more positive efficiency impacts, however. Rochester's transit authority, for example, redeployed 10 of its peak hour runs to the off-peak and shaved its peak fleet of buses following its 1975 lowering of midday fares. Columbus's bus system also reassigned numerous driver tours. There, seat occupancy during the midday rose from 40% to 63%, to the point where the load factors are now the highest during the midday. Columbus's 25 cents midday fare, coupled with free noon-time downtown services, has led to an oversubscription problem, however.

In terms of intensity of use, there was an average decline in revenue passengers per mile among the systems studied, but again this varied

between properties. Notably, in Denver and Columbus, two areas with the largest absolute differentials, this measure increased by 10 percent one year after time-of-day pricing was introduced.

There's also anecdotal evidence that midday discounts have had positive impacts on downtown retail activities in several areas. The most impressive results have been in Columbus where sales tax revenues, which are dedicated to the local transit system, rose nearly 14 percent one-month after the fare incentive was introduced.

Finally, the equity analysis conducted in Chapter Six found that time-of-day fare programs have had fairly modest distributional consequences in terms of ridership composition. In all probability, this reflects the fact that differentials were generally so small as to diffuse impacts among user groups. Among the six systems for which data were available, only in Columbus and Minneapolis did the differential appear to influence ridership mixes to any noticeable extent. In Columbus, the share of older, minority, and low-income users increased overall, however the proportion of choice riders rose markedly during the midday. And in Minneapolis, some shifting of lower income, school-aged, and captive users to the off-peak was found following the add-on of a 25 percent peak surcharge.

In sum, riders generally responded more strongly to off-peak discounts than peak period surcharge programs, though trends varied. Evidence on ridership shifting was rather scant, though discount programs with long designated midday periods and large percentage differentials seemed to experience some redistribution to off-peak hours. Agencies' financial solvency, operating efficiency, and effectiveness at generating additional trips (per unit of service provided) seemed only modestly influenced by time-of-day pricing. Peak surcharge programs, however, generally enjoyed gains in cost recovery rates while discounts programs suffered losses. Finally, arguments that equity benefits will result from time-of-day pricing did not seem to be borne out by this research.

9.1.3 Implementation and Political Issues

Making time-of-day pricing work, both logistically and politically, is a major hurdle to overcome in the minds of many. Several important strategies which facilitated the implementation of time-of-day pricing deserve special attention. Foremost are some of the clever ways devised for coping with the boundary problem. Nearly one-third of all properties collect their differentials on the basis of individual bus runs or arrival at a major activity center rather than according to the specific hands on the clock. Run-based collection virtually eliminates fare disputes, more closely approximates cost variations, and provide the flexibility needed to make differential pricing manageable. In instances where run-based collection is used, individual bus schedules were shaded or printed in bold-face lettering to highlight exactly where, rather than when, fares rates would change.

Special signage was also used to facilitate the fare collection process. Moreover, almost every case, drivers were encouraged to exercise discretion when collecting differentials. Although there was some indication of fare evasion in several areas, overall there seemed to be

a spirit of cooperation between users and drivers in enforcing fare programs.

From interviews and site visits, numerous individuals were polled regarding their reactions as well as the reactions of others to the fare changes. In general, most groups seemed fairly indifferent to time-of-day pricing. Drivers and board members were initially skeptical in some places, though apprehensions tended to wane within several months of implementation. Interviews with drivers revealed that complaints over fare collection were generally related more to matters such as exact payment, multiple passes, and zonal charges rather than the time- of-day differential. In fact, some found time-of-day pricing to be a simplification of previous fare practices. No incidents were found whereby drivers used the differential program and its greater likelihood for fare disputes as a bargaining chip during union negotiations for higher wages. Moreover, a national survey of transit managers found a resounding base of support for time- of-day pricing, which augurs well for its future.

Although there were scattered incidents of user complaints immediately following the introduction of peak surcharges in several areas, acceptance generally came quickly. Aggressive marketing and educational programs certainly had something to do with this. However, the fact that differential pricing was already institutionalized in several areas and that time-of-day fares were actually simplifications of earlier fare practices in others also worked in their favor. Moreover, in that the vast majority of users ended up paying the same fare regularly, the differential itself became a non-issue. There were very few instances of peak period customers complaining about unfair treatment. Apparently, the adoption of fairly small differentials helped to assuage any potential ill-feelings. The most vocal user protests, in fact, were often over the specific designation of the peak hours. In a number of places, users outwardly complained, and perhaps with some justification, that the designated peak hours were too long, thus limiting their abilities to take advantage of lower fares. Although longer peak hours enhance revenues and perhaps reduce the incidence of fare disputes, the discouragement of shifting is perceived by many to be a major drawback.

The overall receptiveness to time-of-day pricing was undoubtedly due, in large part, to effective marketing and user education. A particularly useful marketing ploy used by a number of properties was to sell the fare program to the public as a discount fare rather than a peak surcharge, regardless which one it was. Most off-peak discounts were marketed as bargain and incentive fares, rather than peak/off-peak differentials. This tended to cast each programs in a positive light and also avoided any hint of discriminatory pricing between peak and off-peak users. With peak surcharge and differential increase programs, on the other hand, marketing campaigns often emphasized the benefits of off-peak travel rather than the higher cost of peak period usage.

Private sector involvement with the fare programs was largely limited to business merchants giving away free bus tokens and promotional prizes during the first week or so of the fare program. The give-aways were linked to service improvements as much as the fare programs in most areas, however. Few instances where time-of-day pricing was implemented as part of a flex-time or staggered work program were found. In the

absence of joint public and private coordination of work hour schedules and fare policies, it is not surprising that the level of ridership shifting found was fairly inconsequential.

Finally, the investigation of political events which shaped fare policy outcomes in Cincinnati, Columbus, and Washington disclosed a number of common themes. In all three places, time- of-day pricing, in and of itself, was not the centerpiece of each area's fare policy. Rather, it was part of a larger funding package aimed at accomplishing a specific cost recovery target as well as geographically spreading transit's financial burden. In particular, time-of-day pricing seemed to collect revenues in keeping with how many observers viewed operating costs to vary between central city and suburban areas. Overall, time-of-day fares have not been products of a rational decision-making process, but rather have evolved incrementally in response to concerns over fiscal expediency and regional equity.

9.2 Recommendations and Concluding Remarks

Our insights into the ridership and financial implications of time-of-day transit pricing, though broadened by some of the research findings, nonetheless remain fragmented. In particular, the ability of time-of-day fare differentials to bring about significant shifts in ridership is unclear. Of course, data limitations have been a big part of the problem. But the fact that most of the differentials which have been implemented to date are fairly nominal, plus the absence of a true peak-increase/off-peak-decrease fare change, have been limiting factors as well. Moreover, in that many differentials have been eroded by inflation since they were first introduced, the dearth of significant ridership and performance findings should come as no real surprise. In general, there have been very few, if any, time-of- day fare programs implemented to date which closely capture cost variations between peak and base periods, at least not in line with what peak load theorists have long been arguing for.

If the transportation community is serious about evaluating the effects of a substantial time-of-day fare differential, it is felt that a carefully designed and administered demonstration program needs to be sponsored. A quasi-experimental, controlled setting is imperative if the incidence of ridership shifting induced by time-of-day fares is to be measured. In particular, a baseline of ridership data needs to be gathered before inaugurating the program. Comparable data needs to be collected following the program's initiation. Ridership data should be collected not only in the aggregate, but also broken down by time period, specific user classes, and perhaps types of services. Both short-term (1-3 months) and intermediate-term (1-2 years) assessments should be conducted, symmetrical to the fare change (i.e., with data collected for a comparable number of months before and after). It is also felt that a panel study, wherein the same group of riders are sampled before and after the fare change, would yield the most useful insights into the distributional consequences of time-of-day pricing. Tracing changes in travel behavior for the same group of individuals following the initiation of time-of-day fares would allow specific levels of inter-temporal shifting to be carefully assessed.

An effort should be made to design a demonstration program

involving a combined peak-increase/off-peak-decrease fare change. Depending on an agency's peak-to-base ratio of demand, the size of the differential should be fairly substantial, at least 100%. Budget-permitting, both run-based and time-based fare collection approaches might be studied among several different systems as well. It is also recommended that more research be conducted on the incidence and nature of disputes associated with major reforms such as time-of-day pricing. In addition, every effort should be made to enlist the support of the private sector in coordinating various flex-time and staggered work hour programs with time-of- day pricing. If transit ridership is ever to be significantly redistributed throughout the day, some reassignment of work periods throughout the day will be necessary on a meaningful scale.

This research suggests that both off-peak discounts and peak surcharges, as well as various combinations thereof, can yield substantial dividends to a transit agency, as long as they are implemented carefully and other reinforcing factors are at play. Run-based fare collection approaches seem to be far superior to time-based ones, and are recommended for any agency contemplating time-of-day pricing. Importantly, driver-user confrontations can be virtually eliminated with a well-conceived run-based collection system. Extensive marketing of the fare programs and educational campaigns are also important prerequisites. In particular, the least amount of public resistance seems to be encountered when the differentials are aggressively promoted as bargain off-peak fares, without any mention of higher peak period rates. This marketing psychology can cast the fare program in a positive light without alienating transit's bread-and-butter customers, peak hour riders. It is also essential that careful attention be paid to the designation of peak and off-peak hours when setting up a program, mindful of the trade-offs involved. Although lengthy peak periods probably generate more revenue than narrower ones, they have probably been major deterrents to significant ridership shifting as well. It is felt that peak period time bands need to be seriously re-evaluated in some areas with an eye towards encouraging shifting. Along this same line, every effort should be made to implement time-of-day pricing in combination with flex-time programs. Both public and private sectors would gain by doing so.

Of course, there are no magic formulas that guarantee if an agency does X, Y, and Z, then a successful time-of-day fare program will result. Innumerable factors come into play. Changing gasoline prices, local economic conditions, the leadership skills of transit officials, the introduction of complementary service improvements, the agency's reputation for innovation, and a host of other factors have some bearing on any pricing reform's outcome. But among the factors which a transit property can directly control, run-based fare collection, positive marketing, and the careful designation of time bands can make important differences in whether the program is perceived to be a success or not.

All things considered, it is felt that the prospects for time-of-day pricing in the United States are quite good. A number of exemplary cases have emerged from this research which should provide other transit agencies with a basis for fashioning their own programs. Public transit's changing economic situation, coupled with mounting concern over efficiency and equity, bodes well for time-of-day pricing as a preferred fare policy of the future.

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